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Competitiveness-based Typology of the Russian Regions

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Abstract:

The paper deals with various methodological approaches to regional systems classification and typology setup. The comparative study of existing approaches to regions classification assisted in design and implementation of a competitiveness-based approach to regional classification using clustering algorithms of multidimensional classification.

The designed typology of the Russian regions employs vast dataset on the following groups of indicators: infrastructure development, industrial output performance, investment activity, foreign trade development and intensity, social and economic development, institutional factors, technology gap characteristics and innovation activity parameters.

The output standings of regional typology comprised of 5 unevenly distributed groups of the Russian Federation regions regarding their level of competitiveness: "potential competitiveness leader", "traditional competitiveness factors holders", "outsiders of competition", "moderate competitiveness regions" and "leaders of competitiveness".

Keywords: *Region, regional development, spatial development, typology of regions, competitiveness, regional competitiveness, clustering.*

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1. Introduction

Competitiveness of an economy is a complex phenomenon. It is provided and taken care on several levels including the regional level. Dealing with competitiveness is one of the most relevant issue in federative countries that face significant differentiation across the regions and territories, as well as asymmetries due to natural, historical and cultural factors, and due to the new drives of change as well (Lundquist and Olander, 1999). Strengthening the competitive position of regions by innovations is the way to increase the competitiveness of the whole country. On the other hand, a region's competitive position determines not only its role and place in the whole national economy, but also reflects and predicts the state of all economic agents in the region: enterprises' income, individuals' cost of living, etc., (Gardiner *et al*., 2004; Bogdanova *et al.,* 2016; Bondarenko *et al.,* 2017).

Russian regions are significantly different due to natural, historic, cultural, ethnic and other peculiarities that influence the dynamics of their development. Regional asymmetries appeared quite long ago and have been existent during the long period of time, sometimes decreasing, but more often – constantly growing in line with the growth of differentiation due to uneven growth rates of social and economic development. One of the consequences of such a differentiation is impossibility to use uniform approaches to manage regional development, uniform strategies and complex programs. On the other hand, the multitude of Russian regions makes it irrational to use unique managerial practices developed for each separate region (Menshchikova and Savapin, 2016). The same evidence comes from super-national regions, as shown in Miheeva *et. al*. (2018). This actualizes the task of regions classification and typology creation.

2. Literature review and methodology background

In a contemporary economy high level of competitiveness can be achieved using drastically new approaches that enable new competitive advantages and foster more efficient use of the existing potential. As soon as regional competitiveness is a multi-dimensional characteristic that reflects quality of social and economic space, using the spatial paradigm is most rational (Kolmakov *et al.,* 2019). This is the spatial paradigm that allows to study the problem of regional competitiveness regarding its interrelation and interdependency with economic space transformation processes that takes place within a territory (Serebryakova *et al.,* 2016).

A significant role in competitiveness research was played by Porter, whose key idea was the thesis that major competitive advantages in the global economy often originate from the cluster location (Porter, 1998; 2003). That is why, according to Porter, regional competitiveness is the extent of productivity to which a region utilizes is resources. In this regard one should admit that Porter's definition is the most consistent and allows to link together the three components of regional economy development: natural-resource capital, human capital and industrial output

capital. According to Bristow (2010), the mentioned components also comprise factors of regional resilience – a relatively new concept in regional studies and spatial economies further developed by Polyakova and Simarova (2014) regarding issues of spatial relatedness and inter-regional cooperation and communication.

Regarding the latter there are different methods to valuate competitiveness, that come from macro- and microeconomic studies and from adjacent fields of research, e.g., from finance (Gryzunova *et. al.*, 2018). But most of the Russian regions doesn't have a system of regional competitiveness monitoring which is a significant problem since they are not able to compare their performance with outcomes of social and economic development of other regions. It is obvious that the described situation undermines efficiency of resolving most managerial tasks. Further sophistication comes from the problem of regional competitiveness valuation, which is not fully resolved yet. The existing methods of valuation are mainly fragmented and unsystematic, or they are far from being instrumental in terms of their managerial use. Valuation outcomes and comparison results, as a rule, are consumed paying no regard to the conceptual basis of regional competitiveness management. Our research of the existing managerial practices in Russia allows to note that there is no efficient system of regional competitiveness management.

The regional competitiveness management requires a proper valuation of it, thus it is necessary to draw attention to the problem of choice of proper and relevant instruments and techniques out of the true multitude of them. Having analyzed different methods of competitiveness valuation we distinguish 3 major groups of them. The first group of valuations employs integral indicators based on statistic data or expert-provided data. It allows to rank regions using weight coefficients. If an integral indicator is designed, the two variants are possible:

- one is to select the set of indicators that includes different competitive advantages of regions, to estimate an integral indicator value considering the influence weight of each indicator;
- one is to determine priority competitive advantages and to calculate an integral indicator regarding the objective of regional development.

Such an approach to competitiveness valuation is found in Viturka (2007), according to which all regions are ranked by indicators of industrial output and gross regional product using Spearman correlation coefficient. Alternative approach to valuate competitiveness of a region is proposed by Turok (2004) who introduced the two-component criterion to treat competitiveness as the role and place of a region among the other regions regarding their ability to maintain the high level of individuals' well-being and to employ the existing industrial, financial, labor, investment, innovation and resource potential (Marabaeva and Gorin, 2016).

Prokop and Stejskal (2010) also proposed to valuate regional competitiveness using an integral indicator. The latter is calculated using aggregate indicators that reflect

the level of human capital development, natural resource potential, level of business development, extent of a region's international integration, extent of regional infrastructure development, level of investment activity and political climate, that comprise groups of basic indicators. Integral competitiveness valuation, that includes a system of indicators of regions' economic potential, regional efficiency and performance, as well as competitive advantages, is provided by Benzaquen *et al*. (2011). The valuation outcome is the 5 groups of regions with the high, moderate, average, low level of competitiveness or uncompetitive regions.

The second group of methods proposes to identify the competitive state of a region using a matrix based on a pair of characteristic features. The advantage of this method is the possibility to obtain quality valuations and to identify problems in managing competitiveness. Still it is widely criticized for excess simplification. Moreover, as Voronkova *et al*. (2018) note, proper choice of the two parameters can hardly be formalized.

The third group is based on methods of multi-dimensional classification that allow to consider many criteria of competitiveness. Boschma (2004) proposes to measure a complex value of competitiveness using multi-dimensional clustering by such indicators as unemployment level, monetary income to cost of living ratio, consumer price index, physical output index, gross regional product per capita, actual consumption per capita. We propose to expand this method of valuation by integrating cluster analysis that allows to handle big datasets which is rather difficult using traditional approaches. Cluster analysis assisted to divide the Russian Federation regions into uniform groups with proper identity considering their characteristic features. the result of such a procedure is the set of clusters which are groups of regions have in common properties and specific features.

The most difficult issue is the choice of the set of indicators the most consistent in describing a region's competitive advantages. For example, researchers suggest using generalized combinations of factor groups that include region's geographical position, availability of natural resources, financial system stability, level of market infrastructure development, compliance to international and federal regulations, regional business and innovation activity, ecological and social-economic indicators of a region, human capital and cultural traditions in the region. Another system of indicators to evaluate regional competitiveness (Žítek and Klímová, 2015) includes 5 subsystems of indicators – economic development, social development, innovation development, foreign trade development and institutional development, – each including 5-6 specific indicators of regional development.

3. Results and discussion

To design the regions' classification, we used a wide set of indicators that includes infrastructure, industrial output, investment, foreign trade, ecology, institutions, technology and innovation development across all the Russian regions (Table 1).

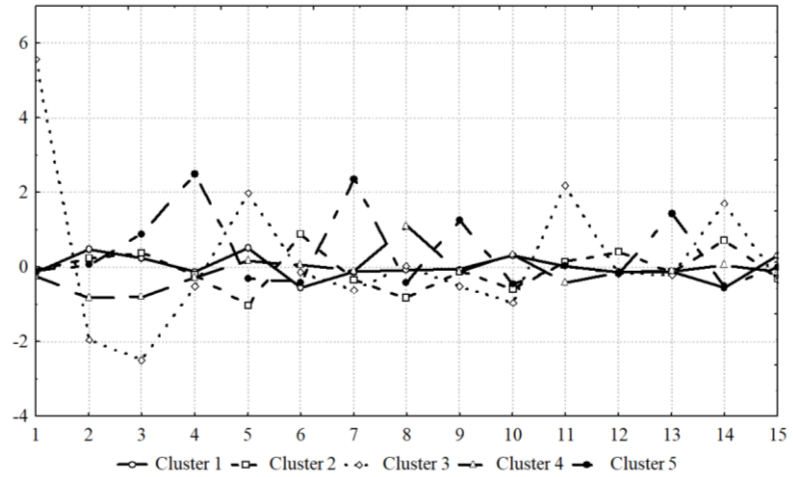
***Table 1**. Basic data to classify regions regarding the level of their competitiveness*

#	Indicator	Measure
Infrastructure		
1.	Number of institutions of higher education	units
2.	Number of university graduates	People x 10^3
3.	Length of public railways per 1000 square km territory	km
4.	Density of public roads with a hard surface per 1000 square km of territory	km
Production – industrial output		
5.	Fixed assets	mln. rub.
6.	Depreciation of fixed assets	%
7.	Foreign capital companies' turnover	bln. rub.
8	Industrial output index	-
9	Agricultural output index	-
10	Energy generation	Bln. kWh.
11	Volume of construction	mln. rub.
12	Retail turnover	mln. rub.
13	Consolidated budget revenue	mln. rub.
14	Proportion of unprofitable enterprises	%
Investment and foreign trade		
15	Per capita gross regional product	rub
16	Fixed capital investment	mln. rub.
17	Fixed capital investment per capita	rub
18	Fixed capital investment per enterprise	rub x 10^3
19	Foreign direct investment inflow	usd x 10^3
20	Consumer price index	-
21	Exports	mln. usd
22	Imports	mln. usd
Social and economic development		
23	Population	People x 10^3
24	Registered diseases per 100 thousand of population	units
25	Registered crimes per 100 thousand of population	units
26	Number of theater visits	People x 10^3
27	Annual average number of employed	People x 10^3
28	Registered unemployment	%
29	Average employed by foreign capital companies	People x 10^3
30	Emission of pollutants to atmosphere	kilotons
Institutional		
31	Number for registered enterprises	units
32	Number of registered enterprises with foreign capital	units
Technology and innovation		
33	Number of personal computers per 100 employees of enterprises	units
34	Number of technology export contracts	units
35	Number of technology import contracts	units
36	Value of exported technologies	usd x 10^3
37	Value of imported technologies	usd x 10^3
38	Number of breakthrough technologies used	units

39	Innovation activity	%
40	Enterprises' expenditure on technological innovation	mln. rub.
41	Innovation goods and services volume	mln. rub.
42	Innovation goods as a proportion to total	%

On the next stage we checked the indicators for multicollinearity, i.e. the condition according to which independent variables might appear highly correlated thus placing a mutual influence on the result. Such an interrelation makes it harder to evaluate and distorts the outcome. Regarding multicollinearity issue, pairwise selection of indicators was made to pick uncorrelated or moderately correlated ones out of the total of 42 indicators. After multicollinearity check only 15 indicators were remaining. They were clustered using K-means algorithm to derive 5 clusters. Figure 1 demonstrates means distribution across the clusters and indicators.

Figure 1. *Cluster means*



Indicator coding is the following:

1 – Registered unemployment
2 – Registered diseases rate
3 – Registered crimes rate
4 – Emission to atmosphere
5 – Fixed assets depreciation
6 – Industrial output index
7 – Energy generation
8 – Length of public railways
9 – Enterprises' expenditure on technological innovation
10 – Innovation goods as a proportion to total
11 – Share of nonprofitable enterprises
12 – Fixed capital investment per capita
13 – FDI inflow
14 – CPI
15 – Number of technology export contracts

Cluster differences are obvious even at this stage. We can take a deeper detail resolving the issue of quality and content of the 5 clusters. First, we need to look at standardized means of the indicators to verify the measure and extent of their difference (Table 2).

***Table 2**. Cluster standardized average values*

Indicator	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Registered unemployment	-0,145	-0,063	5,580	-0,237	-0,100
Registered diseases per 100 thousand of population	0,469	0,248	-1,938	-0,818	0,080
Registered crimes per 100 thousand of population	0,244	0,382	-2,493	-0,797	0,891
Emission of pollutants to atmosphere	-0,126	-0,209	-0,507	-0,282	2,492
Fixed assets depreciation	0,506	-1,011	1,970	0,169	-0,299
Industrial output index	-0,553	0,891	-0,151	0,055	-0,396
Energy generation	-0,119	-0,352	-0,625	-0,093	2,369
Length of public railways per 1000 square km	-0,075	-0,830	0,048	1,104	-0,405
Enterprises' expenditure on technological innovation	-0,053	-0,115	-0,504	-0,121	1,247
Innovation goods as a proportion to total	0,318	-0,577	-0,960	0,345	-0,457
Share of nonprofitable enterprises	0,026	0,141	2,197	-0,417	0,030
Fixed capital investment per capita	-0,146	0,423	-0,161	-0,148	-0,179
FDI inflow	-0,112	-0,120	-0,215	-0,109	1,436
CPI	-0,552	0,734	1,712	0,071	-0,525
Number of technology export contracts	0,308	-0,304	-0,343	-0,124	0,000
The legend	Min.		Mean		Max.

Quantity of regions in a cluster differs significantly. The most populated is Cluster 1 including 38.75% of all the regions. Clusters 2 and 4 contain 26.25% and 25.0% respectively. Remaining 10% of regions comprise two clusters, one of which consists of only 2 regions (Cluster 3; 2.5%), another – 6 regions (7.5%).

Members of clusters and their differences require comments. Thus, the cluster of competitive outsiders (Cluster 3) that includes 2 regions is characterized by unsatisfactory levels of the most indicators (13 out of 15). Their financial and economic development indicators have the worst values: the highest depreciation of fixed assets, minimum fixed capital investment, technology obsolescence and so on. Considering social and ecological indicators, the two regions are characterized by the best values: they have minimum disease ratio and crimes ratio, minimum pollution, that in turn doesn't mean having any competitive advantage. Low pollution means low industrial output and power generation which together comprise economic activity factors and evidence. Relative social protections could be just the short-term effect of public policy measures taken recently. That is why those regions fall into the worst category.

Special attention is to be drawn to the cluster of competitiveness leaders (Cluster 5) that includes regions leading in social and economic development as well as

industrial centers. Their primary difference is significantly higher level of technology innovation expenditure and foreign direct investment inflows. By the 2 indicators this cluster's regions are far ahead of all the other regions of the Russian Federation. High volumes of electricity generation refer to its extensive consumption which is the evidence of industrial activity seen indirectly from higher air pollution. Still, fixed capital investment per capita in Cluster 5 is the least of all the regions. That is due to relatively high population: the evidence comes from the higher value of this indicator attributable to the group of regions with traditional factors of competitiveness which includes less populated regions. Therefore, the regions of the Cluster 5 are denoted as competitiveness leaders.

The most populated cluster (Cluster 1) entails 31 regions that are identical in the highest activity levels in technology exports, highest stability of consumer market, minimum consumer price index, relatively slower growth rates of industrial output and the worst values of disease ratio. All the letter together are a significant stimulus to develop factors of competitiveness: the second highest values of atmosphere pollution and of fixed assets depreciation stimulate investment growth in technology and innovation expenditure which finally facilitates the growth of share of products exported and supplied to the domestic market. Thus, regions of Cluster 1 are the most motivated to follow the innovation path of development that allows to characterize their competitiveness as potentially leading.

Cluster number 4 populated by 20 regions includes territories with the highest share of innovation output in the total output, minimum unemployment rate and minimum share of unprofitable enterprises. Regions of Cluster 4 are on the second place from Cluster 5 in terms of industrial development, investment and innovation activity. They are characterized by average or above-average values of ecology and social development. These regions are classified to moderate competitive position, strengthening of which is possible in short term and long-term perspective.

Regions of Cluster 2 may be characterized as traditionally industrial with the low level of innovation and investment activity. Being the growth rate dynamic leaders in industrial output those regions employ already modernized but more frequently under-depreciated facilities manufacturing minimum proportion of innovation goods with moderate level of expenditure on research and development.

4. Conclusion

The model we made allows to obtain more precise and detailed knowledge of regions' classification regarding their competitiveness. The obtained knowledge of differentiation criteria will allow to further justify the selective use of instruments of handling regional competitiveness depending on its type, based on parameters of competitive specialization, efficiency of regional output system and on a level of innovation activity, as well as innovation development parameters.

The existing pluralism on the issues of regional competitiveness identification can be resolved beyond the theoretical realm but in the managerial practices, especially on the strategic level of governance. We are right to assume that the approach promoted by many researchers based on pointing competitiveness out of some set of relatively interdependent indicators of social economic system, is wrong and outdated, because competitiveness measure does not define the phenomenon itself. Therefore, it should be treated something akin to strategic management derivative. This is the reason to implement systemic approach to competitiveness management lying beneath the grounds of strategic management of regional development.

In terms of practice it's necessary to integrate competitiveness into mechanisms of strategic management not on the level of goals and objectives but on the level of the basic concept using the following analogy: “total quality management” put forward to the philosophy of “total competitiveness management”. In that case it is getting possible to provide different levels decision making subordinate to the logic of increasing competitiveness.

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