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CLUSTERING AS THE FACTOR OF DIFFERENTIATION DECLINE IN THE LEVELS OF TERRITORIES' DEVELOPMENT [*]

The article substantiates the possible decrease of differentiation in regions' development through to clustering. On the basis of P. Krugman's systematization of the development factors in regions' competitive advantages formation the authors have constructed the hierarchical model of factors of territories' differentiation. The results of econometric analysis have become the ground for the development of the concept of territorial differentiation decrease on the basis of clustered forms of interaction. It is proved that efficient institutes of clustered systems' formation and functioning should provide balanced advanced development of national economy overall due to synergy effect. Competitive advantages of some regions will promote the development of economic activity in other regions.

Keywords: innovation clustered structures; regions differentiation; territorial cluster; innovative innovation development.

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КЛАСТЕРИЗАЦІЯ ЯК ЧИННИК ЗНИЖЕННЯ ДИФФЕРЕНЦІАЦІЇ РІВНІВ РОЗВИТКУ ТЕРИТОРІЙ

У статті обґрунтовано можливості зниження диференціації розвитку територій за рахунок кластерізації економіки. На основі розробленої П. Кругманом класифікації факторів формування конкурентних переваг регіонів побудовано ієрархічну модель чинників диференціації територій. Результати економетричного аналізу стали базою для розробки концепції зниження територіальної диференціації за рахунок кластерних форм взаємодії. Обґрунтовано, що ефективно функціонуючі інститути формування та функціонування кластерних мереж забезпечать рівномірний поступальний розвиток всієї національної економіки, передусім, за рахунок ефекту синергії. При цьому конкурентні переваги одних регіонів будуть активізувати розвиток економічної діяльності в інших регіонах.

Ключові слова: інноваційні кластерні структури; диференціація регіонів; територіальний кластер; інноваційний розвиток.

Форм. 5. Рис. 2. Табл. 1. Літ. 26.

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КЛАСТЕРИЗАЦИЯ КАК ФАКТОР СНИЖЕНИЯ ДИФФЕРЕНЦИАЦИИ УРОВНЕЙ РАЗВИТИЯ ТЕРРИТОРИЙ

В статье обоснованы возможности снижения дифференциации развития территорий за счет кластеризации экономики. На основе разработанной П. Кругманом классификации факторов формирования конкурентных преимуществ регионов построена иерархическая модель факторов дифференциации территорий. Результаты эконометрического анализа стали основой для разработки концепции снижения территориальной дифференциации за счет кластерных форм взаимодействия. Обосновано, что эффективно действующие институты формирования и функционирования кластерных сетей обеспечат равномерное поступательное развитие всей национальной экономики, прежде всего, за счет эффекта синергии. При этом конкурентные преимущества одних регионов будут активизировать развитие экономической деятельности в других регионах.

Ключевые слова: *инновационные кластерные структуры; дифференциация регионов; территориальный кластер; инновационное развитие.*

Problem statement. According to the statistics, in Russia about 10% of the total number of regions form more than half of the total gross regional product of the country (The Federal Treasury of RF, 2015). Sharp interregional differentiation leads in the increase of the number of regions with lower income per capita than the national average. At the same time, high level of per capita income, which indicates high level of socioeconomic development of a region, does not determine high level of innovation activity. As a result, scientists have mentioned the divergence of regional socioeconomic systems. These processes reduce the rate of socioeconomic development of the national economy overall.

This actualizes the problem of the choice of methods, instruments and solutions aimed at stimulation of innovative activity of territories. One of these instruments is regional innovation clusters. The cluster-network economy organization may be a significant spatial alignment instrument of territorial development, both innovative and socioeconomic. Understanding the effectiveness of cluster policy as the factor of differentiation smoothing of regional development levels is needed for further elaboration of the government strategy of innovative development.

Recent research and publications analysis. Interregional differences in the levels of welfare and economic development have been thoroughly studied by M. Akhmetova et al. (2014), P. Evans et al. (1996), N. Gennaioli et al. (2013), S. Nahar et al. (2002), Y.K. Persky (2008), S.J. Rey (2001) and many others. Most of scholars reserve the opinion that differentiation decrease in territories' development is possible due to the use of instruments and institutes of innovative development. The problems of innovative processes' formation and development, including the processes on the mesolevel, have been studied considerably by foreign and Russian scientists: V.S. Bochko (2010), G. Grossman et al. (1994), N.V. Katukov et al. (2012), E. Kutsenko (2014), K. Morgan (1997), S.D. Valentey (2014) and others.

We should also mention theoretical and applied researches determining territorial clusters as the most important condition for innovative development of economy: E.M. Bergman et al. (1999), Ch. Ketels (2004), T.Yu. Kovaleva (2012), E. Kutsenko (2015), G. Lindqvist et al. (2013), G. Meier zu Kocker et al. (2015), M. Porter (1998), D.P. Woodward (2012).

Insufficient consideration of the above problems, theoretical and practical importance of their solution have determined the concept and the main goal of this research.

The research objective is to develop theoretical propositions and practical recommendations concerning the formation of innovation clustered structures as the meaningful condition for interregional differentiation smoothing.

Key research findings. As of year-end 2014 Russian economy demonstrated the minimum economic growth rate (0.6%) since 2009 (Federal State Statistics Service of RF, 2016). As a result, Russia dropped to the 15th place in cross-country GDP rankings in absolute terms of GDP and to the 53rd place in terms of GDP per capita (IMF, 2015). Moreover, Russia's GDP decline as of year-end 2015 to 3.8% (Federal State Statistics Service of RF, 2016). This mainly happened due to imposed trade sanctions and the fall of oil prices.

As known, a significant part of Russian Federation's consolidated budget revenues consists of the revenues from oil and gas resources. Only oil and gas revenues formed more than half of the actual revenues of the federal budget (The Federal Treasury of RF, 2015). For that matter, the current political situation will have negative impact on budget revenues and as a result on the functioning of the real sector. Indeed recession of industrial production in the country in 2015 amounted to 3.4% as compared to the identical period in 2014 (Federal State Statistics Service of RF, 2016). Thus, there is an obvious need to minimize the dependence of the domestic economy from oil prices fluctuations through the development of internal production, particularly, through the development of innovative high-tech industries.

Innovative development of a country is innovative development of its territories. Therefore, study of innovative development at the regional level is of particular significance today. Innovative regional development is impossible without interregional integration. This integration provides free movement of products, investment and labor. In Russia, interregional integration is complicated due to significant distances between regions and undeveloped transport infrastructure. Consequently, Russian economy is characterized by strongly uneven spatial development, both socioeconomic and innovative. This conclusion is supported by extensive empirical data obtained by both domestic and foreign researchers. Thus, according to the research results obtained by the National bureau of economic research (National Bureau of Economic Research, 2013), the difference between the level of GRP per capita in the richest and the poorest regions of Russia is about 25 times (Figure 1).
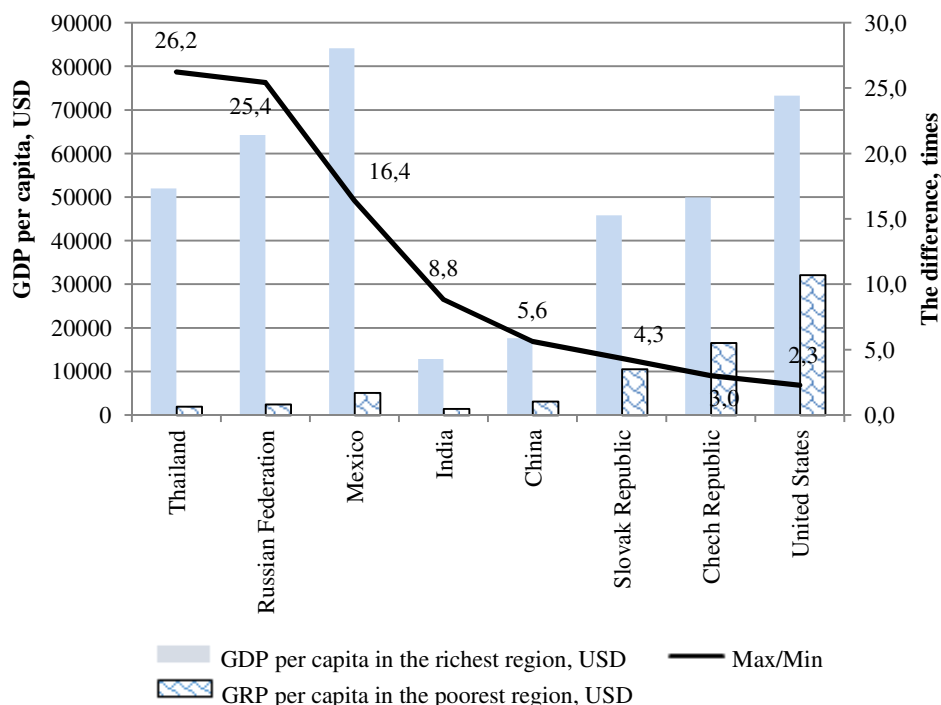

Figure 1. **Interregional differentiation in the world**
(National Bureau of Economic Research, 2013)

According to the statistics, in Russia only 8 regions in the total number of regions (85 regions) form more than half of the total GDP of the country. Interregional differentiation leads to the expansion of regions with lower income per capita than the national average.

At the same time, high levels of basic socioeconomic indicators of regional development such as the volume of investment in fixed assets, the average financial security of a region per capita, the share of employment in small enterprises, unemployment rate, pollutant emission from stationary sources, expected life interval at birth, the level of education etc. can be recorded by the state statistical agencies. Meanwhile, the level of regional innovative development, characterized by an integrated assessment of these important indicators as the volume of innovative goods, works and services as a percentage of the total volume, number of personnel involved in R&D, number of students enrolled on the programs of bachelor and master studies, internal R&D costs can be quite low.

This conclusion was proved in our previous research (Dubrovskaya and Akhmetova, 2014). We constructed a typology of regions based on the analysis of indicators of socioeconomic and innovative environment. The results revealed a number of regions with high levels of socioeconomic development but with low level of innovative development. Generally, they are resource-rich territories of Russia. We guess that this "anomaly" is the main reason for interregional differentiation. It explains the problem why a few regions from more than 50% of the overall GRP.

We consider that more accurate description of interregional disparity in social and economic levels of development and innovation can be described by the term "divergence". Divergence defines all developing systems including socioeconomic ones. In this context, we understand "divergence" as the objective evolutionary process of significant variance of indicators of regional socioeconomic systems development under the influence of certain factors.

P. Krugman (1993), the founder of the «new economic geography», created the classification of factors forming the competitive advantages of territories. It consists of two main groups of factors: advantages of the 1st nature and advantages of the 2nd nature. Advantages of the 1st nature include factors, independent of human activity (natural advantages): natural resources supply of a territory, profitability of geographical position, boundary position at global markets. Advantages of the 2nd nature include factors, created by human activity and society: concentration of population and production, agglomeration effect, human capital, development institutes, infrastructure. According to the given theoretical concept we systematized the factors of the first and the second nature (Table 1).

Further, the systematized indicators were included in the following econometric model:

$$Y = aX_1 + bX_2 + c, \qquad (1)$$

where Y — gross regional product per capita; X_1 — the integral indicator of the factors of the 1st nature; X_2 — the integral indicator of the factors of the 2nd nature; a, b, c — coefficients of the regression equation.

Table 1. **Factors of competitive territories' preferences formation,** *author's*

Groups of advantages		Factors of divergence	Statistical indicators
Factors of the 1st nature		Natural resources supply of a territory	Share of mining operations profit in GRP of a region
		Profitability of geographical position (boundary position)	Share of region export in the total exports of the country
Factors of the 2nd nature	Formal institutes	Infrastructure of the territory	- Total area of living space per one citizen on average. - Population per one hospital bed. - Density of public roads with hard surface
		Ecological factors of territory's development	Pollutant emission from stationary sources
		R&D growth	- Number of personnel involved in R&D. - Number of students trained on the programs of five-year, undergraduate and MA courses (per 10000 persons of population). - Internal R&D costs
		Life expectancy of population	Life expectancy at birth
	Informal institutes	Level of shadow economy	- The level of corruption. - The number of registered penal acts in the sphere of economics
		Social sentiment of population	Rating of social sentiment in regions

We identified the level of region's GRP per capita as the explanatory variable for determining the effect of two groups of macroeconomic indicators on the level of territories' development according to Krugman's classification.

Then we selected the defined indicators in different regions of the Russian Federation. Taking into account high level of budget receipts from oil and gas in Russia it is logical to assume the dominance of the factors of the 1st nature in this country.

To check this assumption we selected the indicators of the 1st and the 2nd nature characterizing the development of Russian regions in 2013. The general data base included 14 indicators from 79 regions of Russia[3].

It should be noted that in this study the construction of econometric model (equation) including the indicators of 2013 is connected with the necessity to minimize the problems of "unbalanced selection", emerged as a result of the fact that in the analysis the indicators available in aggregate for the mentioned period are only used.

To calculate the integral index characterizing the groups of factors of the 1st and the 2nd nature the levels of every indicator's importance in their groups of factors with the help of expert appraisal were defined. Integral indices were calculated by the formulas:

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[3] The total number of observations in RF subjects – 79 is explained by the lack of statistics on Chukchi Autonomous District as well as data consolidation for Tyumen and Arkhangelsk Regions.

$$X_1 = \sum_{i=1}^{n} \alpha_i x_{1i}, \tag{2}$$

where x_{1i} — i-factor, characterizing the indicator of the 1st nature, $i = \overline{1,n}$; n — the total number of factors; α_i — expert appraisal of i-factor weight, $\sum_{i=1}^{n} \alpha_i = 1, \alpha_i \in [0,1]$;

$$X_2 = \sum_{j=1}^{m} \beta_j x_{2j}, \tag{3}$$

where x_{2j} — j-factor, characterizing the indicator of the 2st nature, $j = \overline{1,m}$; m — the total number of factors; β_j — expert appraisal of j-factor weight, $\sum_{j=1}^{m} \beta_j = 1, \beta_j \in [0,1]$.

All the factors used for calculation of integral indices of the 1st and the 2nd natures were standardized by linear transformation according to the formula:

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

In the processing of data base normalization of indicators' values by the linear function of the indicator value membership to the standard interval [0;1] was performed. At that, with the appearance of rare outlying data considerably exceeding typical dispersion of showings (as a rule, it concerned highly developed regions of Moscow and St. Petersburg), they were eliminated in the process of normalization. After general data files processing rare outlying data were set extreme values of the general scale (minimal 0 or maximal 1, subject to the value of outlying data).

Construction of an econometric model on the basis of 2013 indicators made it possible to obtain significant functional dependency:

$$Y = 1.229X_1 + 0.447X_2 - 0.063. \tag{5}$$

Verification of multiple regression equation significance (5) using F-criterion showed that the coefficient of determination is statistically important: $R^2 = 92.54\%$.

It has been clarified that $F = 471.45 > F critical = 3.12$ (the critical value of F-criterion was amounted to 2 and 76 of number of the degrees of freedom at the level of significance level equal 0.05), which proves the statistical importance of the regression equation.

Verification performed according to Student's t-criterion testifies the statistical importance of regression equation parameters (the coefficients of regression):

$$|t_{x_1}| = 27.646 < t_{critical} = 1.992;$$

$$|t_{x_2}| = 5.067 < t_{critical} = 1.992,$$

where $t_{critical}$ — the tabulated point of Student's criterion for the level of importance equal to 0.05, and the number of degrees of freedom equal to 76.

The constructed model (5) demonstrates the presence of close relation between the level of territory's development, stated by GRP per capita and the selected by us factors of formation of territories' competitive advantages — the coefficient of multiple correlation r = 0.96.

And with it, according to the derived equation the largest impact on the function is made by the explanatory parameter X_1 — the integral index of factors of the 1st nature characterizing climatic and geographical conditions of the territory. The absolute value of linear multiplier of parameter X_1 is much higher than the absolute value of linear multiplier X_2 characterizing the efficiency of formal and informal institutes of regional development. So, sensitivity of GRP per capita towards the factors of the 1st nature is 3 times higher than sensitivity to the factors of the 2nd nature. The obtained results prove our assumption that despite the evidence of the basic trend of the world economy development has the growing importance of factors of the 2nd nature at the present stage, factors of the 1st nature dominate in the development of Russian regions.

Thus, the analysis revealed that in Russia favorable geographical location and availability of natural resources are the basic factors in the formation of regional development advantages. These factors determine high interregional differentiation and are the main cause of divergence.

On the basis of the obtained findings we build a hierarchical model of the factors of territories' differentiation (Figure 2). We used the key provisions of the hierarchical analysis and Krugman's classification. It should be pointed out that in accordance with the hierarchical analysis of socioeconomic systems, we distributed the zone of regional' factors of differentiation between the levels of the economic system in the order of objects and subjects of management.

We agree with the representatives of the "new economic geography" school that inequality in territorial development cannot be completely eradicated in a market economy. This inequality is a result of objective evolutionary processes. At the same time, we think that government authority must enhance the role of the second nature factors. It is possible by increasing the level of interaction between actors at different levels of economy, both vertically and horizontally. This interaction (factors' intersection zone) will enable expanding spatial boundaries of economic activity in some regions at the expense of others. In Krugman's interpretation, it also implies that favorable location of centers is not wholly determined by natural geography (advantages of the 1st nature), but can also be influenced by history, self-fulfilling expectations and development institutions (Krugman, 1993).

Successful experience of developed countries demonstrates that regional development based on productive interaction can occur through clusters. Common to all cluster programmes is their rationale of increasing the competitiveness of national or regional economies through facilitation of collaboration between companies and research stakeholders (Meier zu Kocker et al., 2015). In Europe clusters are viewed as an integral element in broader industrial innovation processes or systems (Feser, 1998). Clusters as a serious "practical leverage" began to be mentioned only in the 1990s. To a large extent, it happened due to works of M. Porter (1998). Clusters were understood as a group of geographically neighboring companies and organizations connected with them (for example, universities, patent centers, business incubators, trade associations etc.) in definite fields, competing but at the same time performing similar tasks and mutually complementing each other.
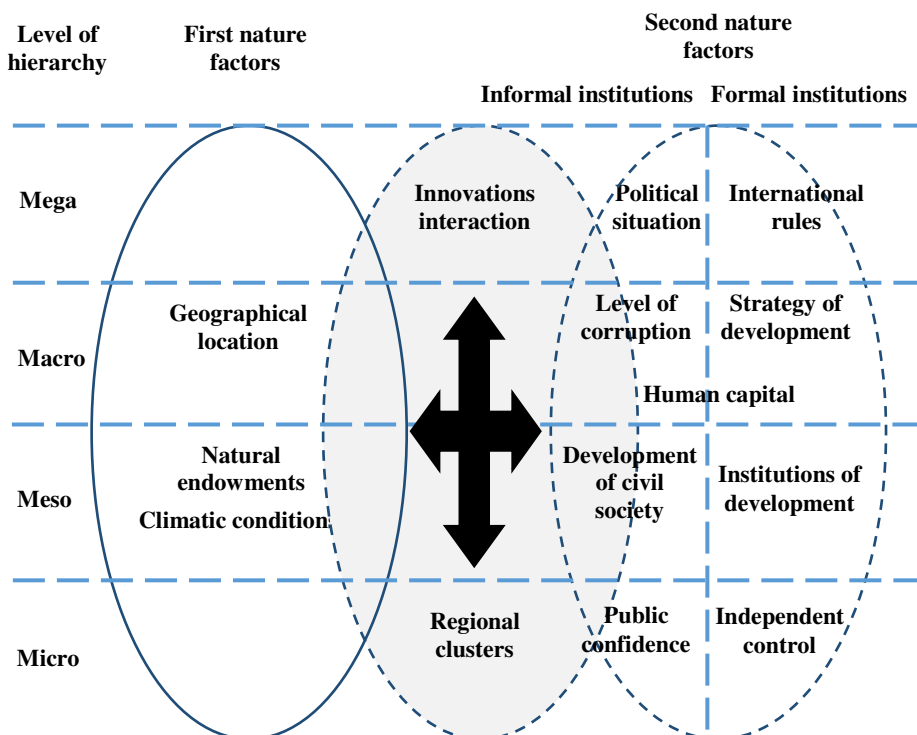
Figure 2. **Hierarchical model of the factors of territories' differentiation,**
author's

Thus, it is necessary to mention that cluster's structure involves different types of participants:

- basic economic subjects – large, small and medium-sized companies in a particular field;

- network of innovative research and education institutions – universities and other institutions, research companies, centers for developments' commercialization, engineering companies etc.;

- group of companies providing other related facilities (financial institutes, consulting companies etc.);

- federal/regional/local authorities.

Thus, clusters are understood as networks of interdependent firms (industrial and service companies) associated with each other in a value chain and operating in a similar market environment; interaction is understood here as the system of economic relations between subjects of regional innovative systems in the framework of certain regional clusters.

Overall, the phenomenon of clustering refers to such objective processes of socioeconomic development as globalization and ICT revolution promoting transition from the industrial type of economy to the post-industrial. Thereby, industrial economic development preconditioned by production growth at the expense of competitiveness increase and economy of scale is transformed into the post-industrial one based on cooperation and partnership.

In June 2012 the RF Government approved the list of 25 territorial innovative clusters, structured into 6 branch-wise directions: "Atom and radiation technologies", "Production of aircraft and spacecrafts, shipbuilding", "Pharmaceutics, biotechnologies and medical industry", "Advanced materials", "Chemistry and petro chemistry", "Information technologies and electronics".

During the analysis of Russian scientific papers and the results of government policy implementation in the field of national economy clustering the authors of this article revealed that innovative policy is being realized on the basis of industrial clusters model up to now. This model is characterized by great dependence of the whole cluster-network system operation from the center (core) of the formed cluster, as well as the dependence of cluster's participants on the priorities of socioeconomic development determined by government authorities.

Obviously, territorial clusters cannot become the factors of growth for national economy, not being an effective instrument for interaction between actors of regional innovation systems. Therefore, the main goal of government is to develop institutions capable to enhance interaction between clusters' members. And from the national policy perspective, cluster promotion strategy will arguably benefit some regions over others, such as peripheral areas subject to backwash effects from strong growth in neighboring regions (Feser, 2013). If this is the case clusters can be a significant instrument for reduction of regional economic disparities.

Conclusion. The problem of territorial differentiation by the levels of innovative and socioeconomic development has been actualized in this article. Using the theory of economic growth, the models of modern economic geography as well the methods of spatial analysis and spatial econometrics the authors have constructed the regression model of resource and institutional groups of factors influence on regional development. This model allows substantiating the dominance of different groups of factors above the level of regional development in economic systems with high differentiation of local territories. Testing of the obtained econometric dependence on the data Russian Federation regions made it possible to construct a theoretical model of territorial differentiation factors and ground the necessity of economy's clustering as the key instrument in organizing efficient institutions to facilitate regional development and interaction.

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