

Zemtsov, Stepan; Baburin, Vyacheslav

Conference Paper

Innovation potential of regions in Northern Eurasia.

53rd Congress of the European Regional Science Association: "Regional Integration: Europe, the Mediterranean and the World Economy", 27-31 August 2013, Palermo, Italy

Provided in Cooperation with:

European Regional Science Association (ERSA)

Suggested Citation: Zemtsov, Stepan; Baburin, Vyacheslav (2013) : Innovation potential of regions in Northern Eurasia., 53rd Congress of the European Regional Science Association: "Regional Integration: Europe, the Mediterranean and the World Economy", 27-31 August 2013, Palermo, Italy, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:

<https://hdl.handle.net/10419/123949>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

INNOVATION POTENTIAL OF REGIONS IN NORTHERN EURASIA

Baburin Vyacheslav¹
Zemtsov Stepan²

Abstract. Northern territories (including the Arctic) occupy over 80% of Russian area. Development of these regions is based on 'resource' model, while other approaches have been ignored because of severe environmental conditions. The aim of this study was to assess an ability of northern regions to generate and diffuse innovations. The study was methodologically divided into three stages.

The objective of the first and the second stage was to compare innovation capacities of northern and other Russian regions. An ability to create new knowledge is described by a number of indexes, the ability to extend and apply innovations - by a logistic function from model for innovation diffusion. This work confirmed the hypothesis of high concentration of the potential in major agglomerations and research centres, including Siberian cities: Tomsk, Novosibirsk, and Krasnoyarsk. Some arctic regions were characterized by high creative potential, but low rate of diffusion: Krasnoyarsk, Magadan, Sakha. The first fact can be explained by conservation of the Soviet scientific infrastructure and by initiative and mutual assistance of northern communities. The second fact is related to low population density and interaction. The key disadvantage of the method is in inadequate quality of Russian statistics.

On the second stage, the authors identified innovation clusters in the sphere of environmental management. This sphere, connected with sustainable development, is a quickly developing innovative sector of economy, which includes remote sensing and GIS technologies, new technologies of exploration, hydro-meteorological and ecological modelling, etc. Leading university centres were identified by expert surveys and verified by 'Delphi' procedures. Centres had formed clusters, which were organized by principal of innovation cycle: fundamental and applied science, and enterprises. More than 30% of organizations were located in the northern regions. To classify the clusters the authors calculated an index of innovation capacity, which included the assessment of competence, new technologies and business-incubators, as well as the index of cohesion: connections and their structural and spatial diversity (Shannon's formula). Using graph theory techniques we identified interregional clusters of the Northern Periphery: Tyumen (Tyumen) and Siberian (Tomsk). Subsequent verification was carried out by analysis of publications and organizations' patent activity. The research shows that arctic regions are actively included in network with universities and science centres, serving as the main consumers of new technologies.

Russian innovation space can be described by core-periphery model: the largest cities, located in the main strip of settlement, are the centres for generation and diffusion of innovation on the northern periphery. Emerging innovation clusters in the sphere of environmental management coincide with territorial structure of existing innovation space, but with significant northern bias. The study shows high innovation capacity of northern organizations in applying of new technologies.

Keywords: regional policy, innovation potential, innovativeness, innovation clusters, Bass model

¹ Professor of Lomonosov Moscow State University (Moscow, Russia). Head of the department of social and economic geography of Russia. E-mail: vbaburin@yandex.ru

² PhD student of Lomonosov Moscow State University (Moscow, Russia). E-mail: spzemtsov@gmail.com

INTRODUCTION

The Northern Territory (including the Arctic) occupies above 80% of the Russian area. Development of these regions is based on 'resource' model, while other approaches have been ignored because of harsh environmental conditions, business model of corporations, etc. The aim of this study was to assess an ability of Northern regions to generate and diffuse innovation in comparison with other Russian regions. Actuality of the work is connected with the problem of 'resource' territories development, which depends on possibility to incorporate new forms of economic activity.

The study was methodologically divided into three stages. The objective of the first stage was to compare innovation capacities of the Northern and other Russian regions. An ability to create new knowledge was assessed by several indexes. The second stage was devoted to assessment an ability to extend and apply innovation - by logistic function from model of innovation diffusion. On the last stage, the authors identified innovation clusters in the sphere of 'rational use of nature', or environmental management. This sphere, connected with sustainable development, is a quickly developing innovative sector of economy, which includes remote sensing and GIS technologies, new technologies of exploration, hydro-meteorological and ecological modelling, etc. Leading university centres were identified by expert surveys and verified by 'Delphi' procedures. They had formed clusters, which were organized by principal of innovation cycle: educational organizations – fundamental and applied science centres – enterprises.

OBJECT AND METHODS

The main object of the research is the Russian Northern Territory, which consist of areas with continental climate, high variation of temperature and permafrost. These areas were identified in the Soviet period for additional 'northern' premium for persons, who want to live and work there. The territory is shown on the scheme (Fig. 1) with all regional centres and main agglomerations of the rest of Russia.

The northern territories consist of 24 regions and occupy approximately 80% of Russian territory, but only 17.5 per cent of total population live here.

Creative component of innovation potential can be expressed as a probability function, which dependent on density and concentration of innovators and intensity of their interaction (Baburin, 2011). The largest cities and closed science cities are the sources of new technologies, forming a "field" of high innovation potential around themselves. Correlation between urban population and number of patents in regions is around 0.86 in 2010. But for Northern regions these factors are very limited. Northern regions have very low population density (2.5 persons

per km²) in comparison with other regions (33 persons per km²), similar level of urbanization (73-74 per cent), moreover, 60 per cent of Russian citizens lives in big cities (more than 200 thousand people), but in the Northern Territory it is only 36 per cent.



Figure 1. Russian Northern Territory.

Regions on the scheme from the west to the east: 1 – Murmansk oblast, 2 – Karelia Republic, 3 – Arkhangelsk oblast, 4 – Nenetsky autonomous district, 5 – Komy Republic, 6 – Perm oblast, 7 – Khanty-Mansiyskiy autonomous district, 8 – Yamalo-Nenetskiy autonomous district, 9 – Tyumen, 10 – Tomsk oblast, 11 – Altay Republic, 12 – Krasnoyarsk kray, 13 – Tyva Republic, 14 – Irkutsk oblast, 15 – Buryatia Republic, 16 – Yakutia Republic, 17 – Zabaykalskiy kray, 18 – Amurskaya oblast, 19 – Khabarovsk oblast, 20 – Primorskiy kray, 21 – Magadan oblast, 22 – Sakhalin oblast, 23 – Chukotka autonomous district, 24 – Kamchatka kray.

Northern regions concentrate 30 per cent of total Gross Regional product (GRP)³, and GDP per capita is about 10 thousand euro. It is higher than in the rest regions (8 thousand euro) but the price for good living condition is also higher (family expenditures are higher on 26 per cent). The regions on the North concentrate 36 per cent of total fixed assets in the country, 38 per cent of investment, 36 per cent of total industry production and 75 per cent of mining production.

The first part of the research was devoted to creative activity of regions and creative-acceptor functions. The cartogram⁴ of patent activity was prepared. The typology of regions by its creative and acceptor functions was developed with the help of cluster analysis. The indicators for analysis were patent activity (patents per city citizens) and patent consumption (percentage of used patents). The results were compared with the Soviet period. Because of

³ GRP (Gross Regional Product) is an equivalent of GDP (Gross Domestic Product) on regional level

⁴ The program «Cartogram Utility for ArcGIS», based on the method developed by M. Newman and M. Gastner (Gastner, 2004), was used as an application (utility) to the program ArcGis 9.3.1

statistics drawbacks, an average annual value of patent activity from 2007 to 2012 years was used. In cases, where the coefficient of variation was more than 0.3, the median was used.

The official Russian statistics (from the Federal State Statistics Service) is not perfect because of lack of uniform and clear standards in innovation sphere⁵. That is why, it is impossible to use one indicator to estimate regional potential. There are several international indexes, used for estimation of innovation development: Innovation Index of World Bank, Innovation Capacity Index, European Innovation Scoreboard, etc. Most of them include patent activity as an indicator. Some of Russian regional indexes are based on international methods.

For further estimation index of creativity, based on R. Florida approach and developed by A. Pilyasov, was used with several modifications. According to available data of Russian statistics several indicators were used:

1. Subindex of talent: human capital (percentage of employees with higher education, %) and scientific talent (number of researchers per 1 million inhabitants).

2. Subindex of technology: science investment (R & D expenditure per GRP, %) and patent activity (number of patents granted per million inhabitants).

3. Subindex of tolerance: ethnical diversity (percentage of households, where members are of different ethnic group, %) and international attractiveness (percentage of migrants from outside Russia in total arrivals, %; number of migrants per 10 thousand inhabitants).

The equation of linear scaling was used to normalize data (Eq. 2):

$$I_i = (X_i - X_{\min}) / (X_{\max} - X_{\min}) \quad (1)$$

where I_i is an index, X_i is an investigated figure, X_{\min} is the smallest element in a group of compared figures, X_{\max} is the greatest figure. The subindexes and the integral index were calculated as the arithmetic average of indicators. Index was calculated for 2010 year.

Considering the disadvantages of previous methods the authors have collected a large database of 38 indicators, based on expert interviews and existing literature (Fagerberg, 2007; Lundvall B., etc.), and conducted factor, correlation and normal distribution analyses.

On the last part of factor analysis all indicators were divided into two main factors: 'absorption' and 'creative' potential.

The first one (upper on the Fig. 2) consists of several indicators: urbanization (%), computers with Internet access per 100 employees, GDP per capita, percentage of multinational families (%), percentage of Internet-users (%), and mobile phones per capita. The indicators can be used to assess absorption potential because of high value of GDP, development of net services.

⁵ Variation in definitions of 'innovative production' leads to leadership of the Republic of Chechnya (agro-industrial region of the Caucasus) in Russia by an indicator of innovative production percentage in total production.

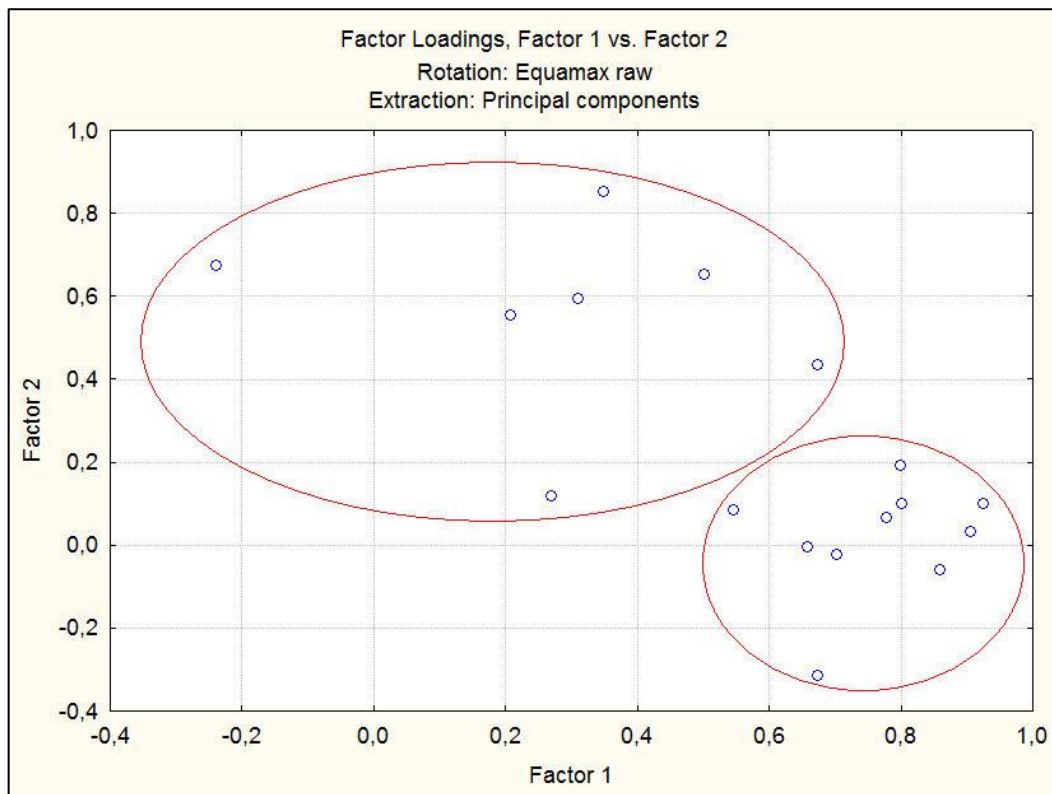


Figure 2. Factor loadings.

The second one was used as an element of innovation potential estimation. The selected indicators have a simple interpretation: each of them either increases the probability of innovation generation, or an indicator of innovation activity itself. The identified indicators are: estimation of economic-geographical position; percentage of residents in cities with population more than 200 thousand people (%); percentage of people with a higher education in the population (%), number of university students per 10 thousand people; percentage of employees in R & D sector in total employment (%); percentage of organizations with a website (%); number of registered patents per 1000 employees. The indicators were normalized (Eq. 3); integral index was calculated by the arithmetic average of indicators.

The similar index but only with indicators, that describes abilities of regional innovation system, was developed. The index comprise of indicators for each stage of innovation cycle: education (number of university students per 10 thousand people) – research (percentage of employees in R & D sector in total employment (%)) – generation of innovation (number of registered patents per 1000 employees) – production (percentage of organizations with a website (%)).

The last stage of innovation cycle ('consumption') was described by model of innovation diffusion. The assessment of creative potential is not enough, because there are a lot of non-domestic technologies, which can greatly improve innovation capacity of the regions. An ability to absorb and disseminate new technologies can be described by the rate of diffusion in long

time series. The most useful indicator is mobile phones usage, or subscriptions (active SIM cards per 100 people). It is open and full data and it is hard to fabricate or mislead, because companies are interested in accurate information. All the regions are covered and Russia is one of the leading countries in this sphere. All regions were classified by cluster analysis (in statistical package Statistica 6.0) according to rates of diffusion in each year.

The regions were classified based on ‘innovation’ and ‘imitation’ parameters for a diffusion function (Bass Model) on the same example. Bass (Bass, 1969) considered a population of N_{max} individuals who are both innovators (those with a constant propensity to purchase, a) and imitators (those whose propensity to purchase is influenced by the amount of previous adopters, b) in so-called mixed-influence model ($(a + b)$ controls scale and (b/a) controls shape). The model can be rewritten from original differential form (2)

$$dN(t)/dt = [a + b*N(t)]*[N_{max} - N(t)] \quad (2)$$

in terms of its discrete analogue (3)

$$N(t+1) - N(t) = a*N_{max} + (b - a)*N(t) - b/N_{max} * N(t)^2 = A_1 + A_2*N(t) + A_3*N(t)^2 + e(t) \quad (3)$$

where $a = A_1/N_{max}$, $b = -A_3/N_{max}$, $N_{max} = (-A_2 \pm \sqrt{(A_2^2 - 4*A_1*A_3)})/2*A_3$.

This equation were used to estimate parameters (a , b , N_{max}) of the model (Mahajan, 1985). Proportions of ‘innovators’ (value of a) and ‘imitators’ (value of b) in total growth rate (‘total adds’) were established for each region to verify the model. Comparison of model and real values of total growth has led to the conclusion that our model overstates the value of the parameter a . The real growth in 1999⁶ should be used for estimation of innovativeness. Cluster analysis by parameters a and b was made.

Structural analysis is not sufficient to identify the internal mechanisms of the spatial organization of innovation processes and its future directions. Internal relationships within quickly developing innovative sector of economy were additionally analysed. ‘Environmental management’ includes remote sensing, GIS, new technologies of exploration, hydro-meteorological and ecological modelling, etc. The technologies are organized in innovation cycles.

Based on Foresight methodologies (Jantsch, 1965) leading universities were identified by expert surveys and verified by ‘Delphi’ procedures. The participants of the expert network from the universities filled out questionnaires, in which they indicated the competence of the university, associated organizations, new technologies developed over the last 3 years, the

⁶ All of the adopters in 1999 can be considered as ‘innovators’, because it was the first year in Russia, when mobile operators began to spread all over the country after separation and sale of GSM frequencies by the government.

number of centres for technology transfer. All associated organizations were assigned to different stages of the innovation cycle: education - research - enterprise. The whole cluster includes 130 organizations: two universities – forecasting centres and 12 universities – members of the network, interacting with outside universities (12 organizations), research organizations (42) and entities (62).

To assess potential of identified regional innovation clusters (RIC – set of organizations within innovation cycle in one region) two indexes was developed (Fig. 14): the index of competence (I_{KMP})

$$I_{KMP} = (I_C + (I_{NT} \times I_{VIZ})), \quad (4)$$

where I_C – subindex of the number of university competencies, I_{NT} – subindex of new technologies, I_{VIZ} – subindex of transfer centres; and the index of interaction (I_{VZ})

$$I_{VZ} = I_{SV} \times I_{TR} \times I_{SR}, \quad (5)$$

where I_{SV} – subindex of the number of associated organization (or interactions), I_{TR} – Shannon index of the share of connections between different cities, I_{SR} – Shannon index of the share of organizations of different stages of the innovation cycle. Sub-indices are calculated according to the formula of linear scaling (3), the use of which is justified, since there is no significant variation of data. Moscow cluster have been excluded from the analysis because of its high values.

RESULTS AND DISCUSSION

1. INNOVATION POTENTIAL AND INNOVATIVENESS

Patent activity in Russia declined significantly from 60000 granted patents in 1989 to 22500 in 2012. Activity in the Moscow core decreased from 230 to 30 patents / 100 thousand residents in 1999, in the 2000s the process slowed down, but in the 2010 it remained below the regional average level of the USSR in 1989⁷. The most significant decrease in the density of the field is observed in Samara (automobile and aerospace industries), Voronezh (electronics, petrochemistry and agriculture) and Rostov (agriculture and agricultural machinery) regions. The percentage of the northern regions is about 3.3 and stable in 2000.

Meanwhile, concentration is growing. In 2002, 40% of all patents were concentrated in four major regions (Moscow, St. Petersburg, Moscow region and the Republic of Tatarstan); in 2010 it is reached 50%, the situation in Northern regions is similar: 52 per cent of patent activity is concentrated in Perm', Krasnoyarsk and Tomsk. The cartogram of patent activity (Fig. 3.1)

⁷ Absolute indicator for Moscow is about 6000 patents in 2011, which is corresponding with patent activity of the most innovative company in the world IBM (USA) in 2011.

demonstrates the level of polarization. The size of polygons (region borders) was changed, so it matches the corresponding absolute indicator (the number of patents).

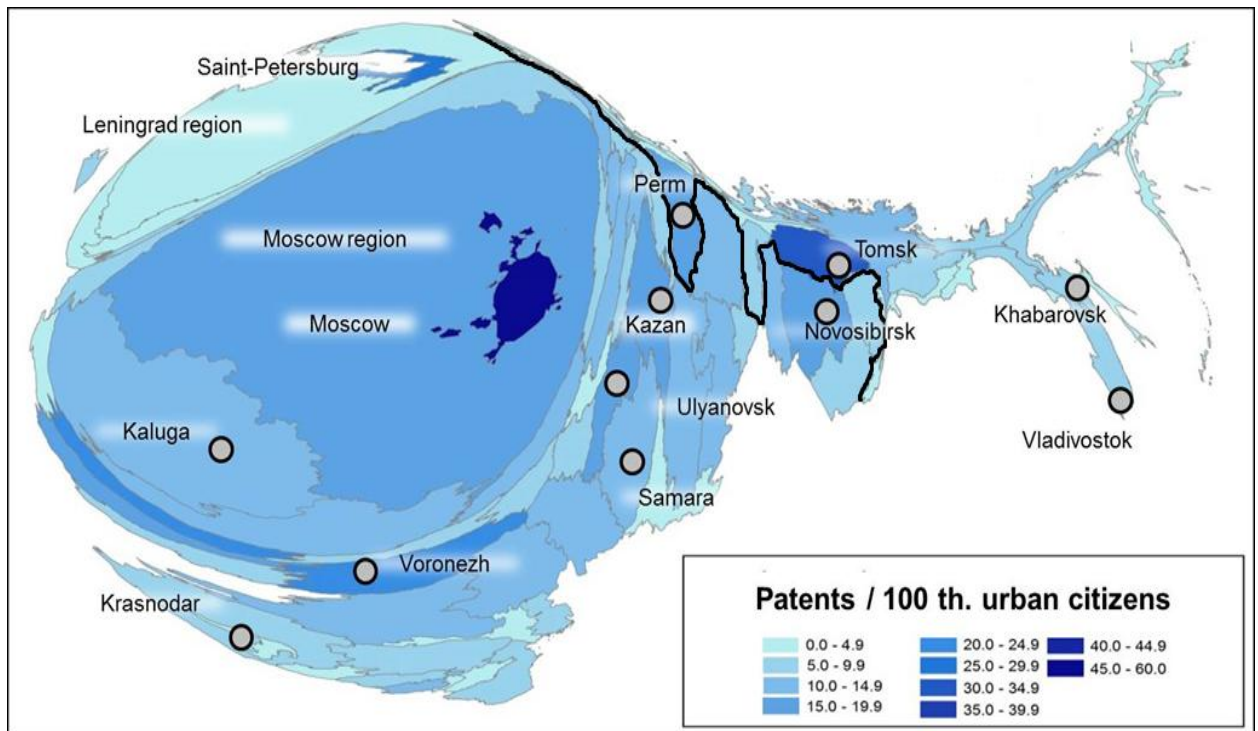


Figure 3.1. Cartogram of patent activity in Russian regions in 2010. The black line shows Russian Northern Territory.

To determine a place of the Northern regions in creative-acceptor functions, cluster analysis was held (Fig. 3.2).

Innovation "core" is mainly concentrated in the multifunctional urban agglomerations⁸: Moscow, St. Petersburg, *Tomsk*, Novosibirsk, Kazan, *Perm*, Samara, and Rostov-on-Don. A limited number of regions retained creative functions (Voronezh, Ulyanovsk, Orel region, Republics of Tatarstan and Bashkortostan). Several innovation centres are outside of Russia (Kiev, Minsk, Kharkov, etc.); many of them lost their innovative features (Armenia, Moldova, Alma-Ata, etc.). Most of the Northern regions became peripheral, although it was strong acceptors in 1989.

These methods allow identifying cores and periphery, but have several disadvantages. Only one indicator was used to assess the multivariate phenomenon. Patents are not innovations, but novations, which may not be implemented. Patents can be used for evaluation of potential only in technological sphere. Most of patents in Russia are improving novations and/or may not have commercial value.

⁸ Indicator of the proportion of people employed in R & D of the total employment was used for verification; both indicators form close spatial structures.

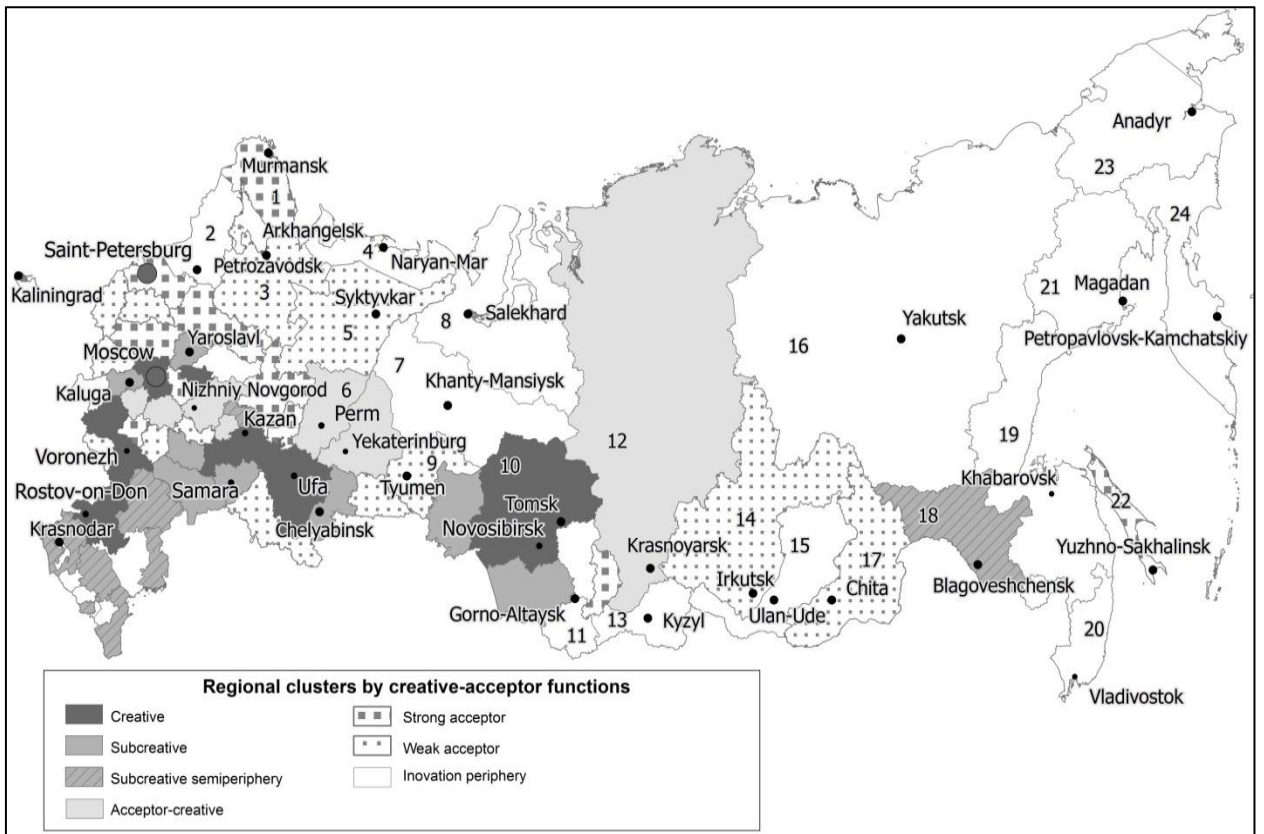


Figure 3.2. Creative-acceptor functions of regions in 2010. The numbers are indicators of the Northern regions (see Fig. 1).

The index of creativity was used to estimate an ability of regional society to generate new idea, technologies, etc.



Fig. 4. The index of creativity.

The regions were divided in 4 categories: *creative* (Moscow, St. Petersburg, Tomsk, Nizhniy Novgorod and Kaluga regions), *subcreative*, *semiperipheral* and *peripheral*. Most of the northern regions are peripheral, except Tomsk, Khanty-Mansiysk and Kamchatka, which have a greater level of tolerance.

The main disadvantage of the approach is low or very high correlation between indicators, which may average values of the integral index between regions. There is a very low correlation between the patent activity and the indicators of the subindex of tolerance.

The integral index of innovation potential was calculated as a ‘Factor 1’

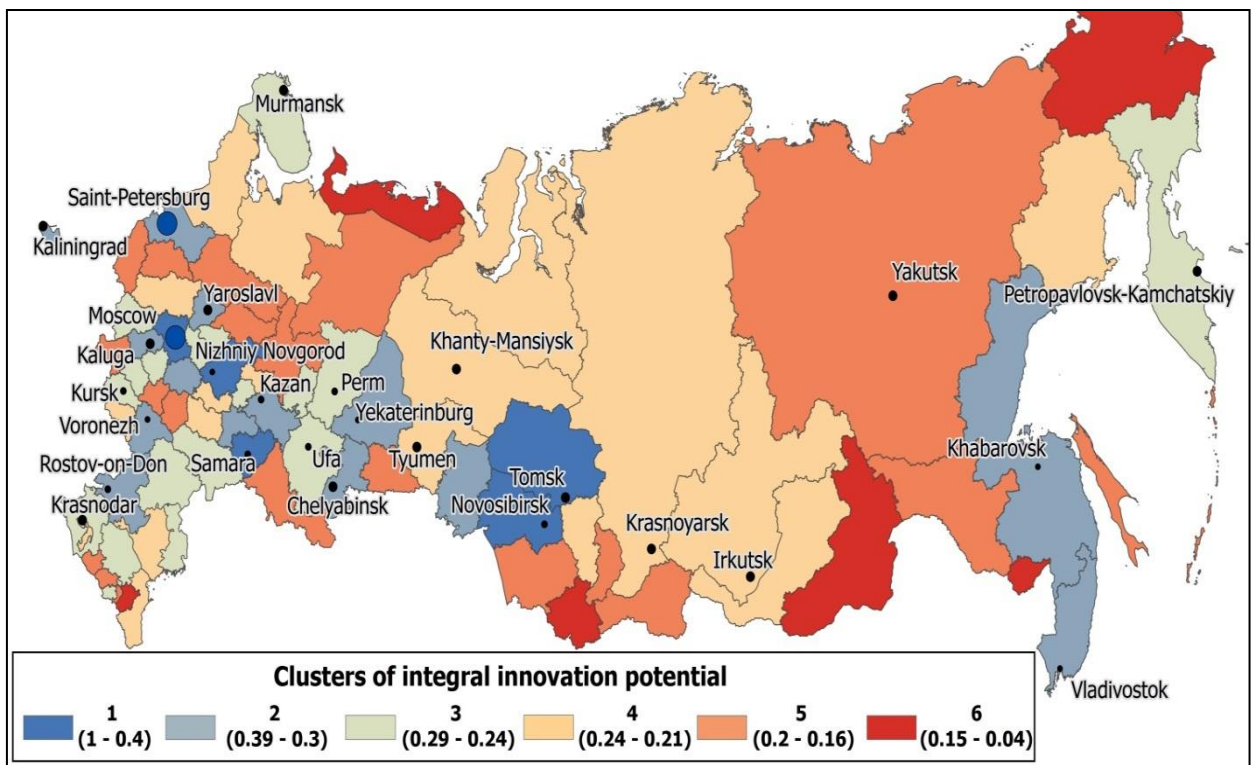


Fig. 5. Index of regional innovation potential in 2010.

Six groups of regions were identified:

1. ‘Innovation core’ with the largest agglomerations and scientific cities, specialized on microelectronics, nanotechnology, aerospace industry, and other hi-tech industries; all stages of innovation cycle are well developed.
2. Highly developed regions with large scientific centres, developed stages and diversified economic structure, specialized on machinery production.
3. Regions with a strong science sector, which may be specialized on one or a few spheres, but not all the stages are developed; concentration of military-industrial complex is common.

4. Regions of basic sectors of the economy (metallurgy, mining, oil and gas production, transport machinery, forest industry, and agriculture).

5. Regions with limited potential, without some stages; can be characterised by demographic problems and/or unprofitable sectors of the economy;

6. Peripheral regions without most of the stages.

There are several weaknesses of the technique: the lack of quality of Russian statistics, unverifiable data for a number of regions, averaging of the overall assessment. The index can be used to conduct regional policy, allocation of foreign innovative company research centres, etc.

2. INNOVATIVENESS OF THE NORTHERN REGIONS

All regions were classified by cluster analysis (in statistical package Statistica 6.0) according to rates of diffusion in each year (Fig. 6). When the middle-staged regions achieved 100 % level of saturation (one phone per person) in 2006, the diffusion could be ended, but the new ‘wave’ of smartphones, communicators, and netbooks came, following the development of the mobile Internet.

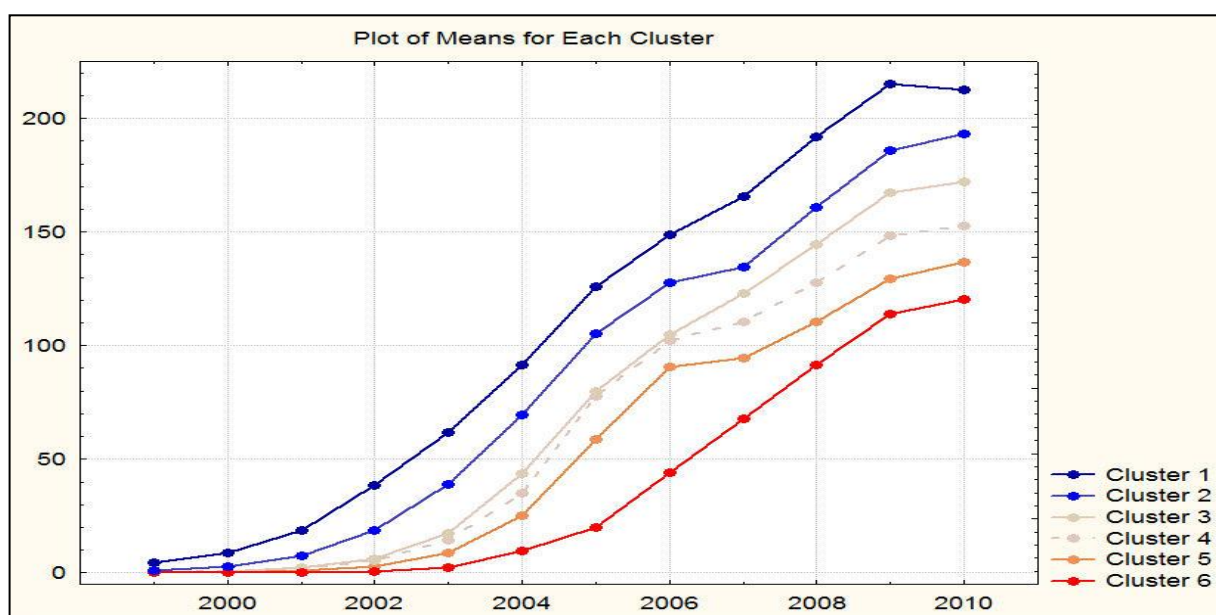


Fig. 6. Clusters of diffusion. SIM cards per 100 people.

In the 1st cluster (Fig. 7) are the ‘capital’ regions. The 2nd cluster is filled by high income regions and regions with exceptional geographical position (with an agglomeration or on a border). The 3rd and 4th clusters are divided in 2006; it is quite homogeneous group of ‘middle’ regions with average values. There are some regions with low population density in the 3rd cluster; people start to use phones more actively to connect because of lack of real meetings. In both clusters there are some agglomerations. The 5th cluster is mostly represented by agrarian territories. Regions of Northern Caucasus and Far Eastern district are in the last cluster.

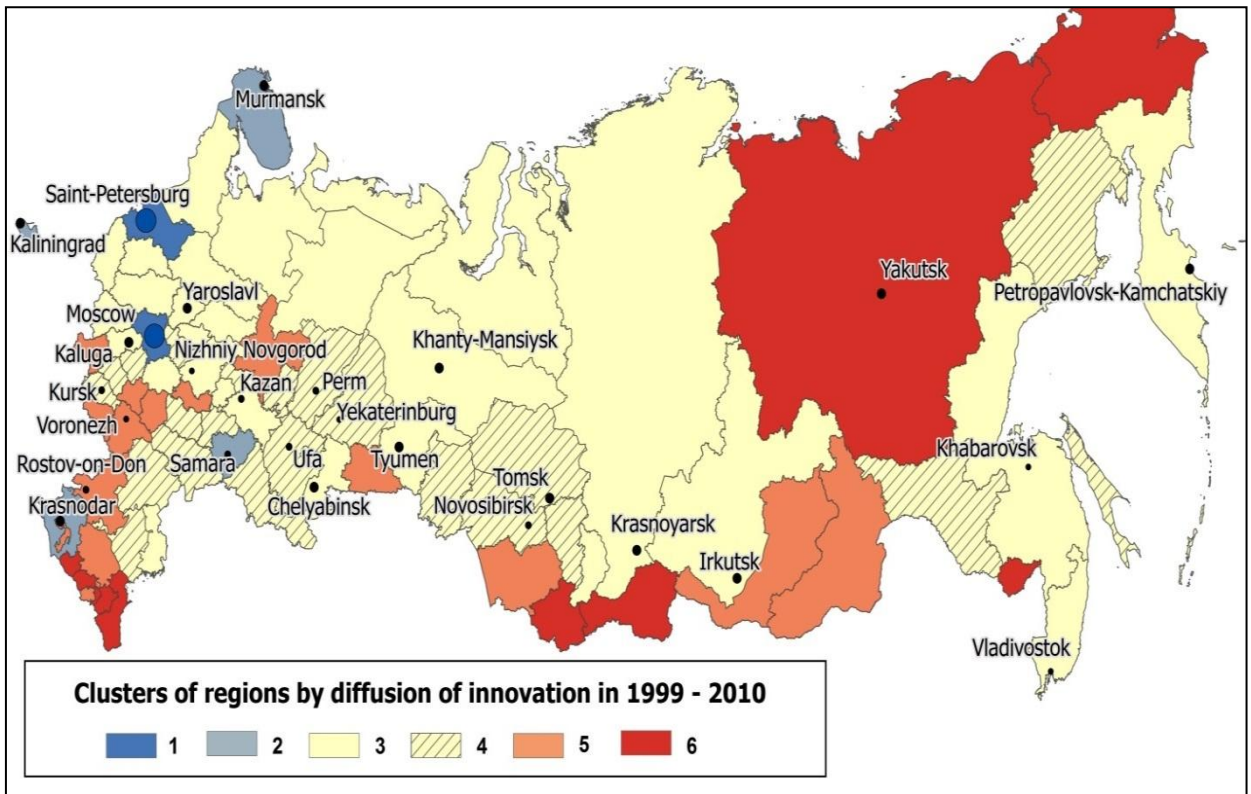


Fig. 7. Diffusion classification of regions based on the data series from 1999 to 2010.

The main critic of the method is related with underestimation of the intrinsic properties of the process. Different factors can work on different stages of diffusion, but the method can average it.

The distribution of total number of mobile SIM cards between clusters (3rd and 4th clusters were united) tends to the normal distribution by 2006 (Fig. 8), but after 2006 the new 'wave' came.

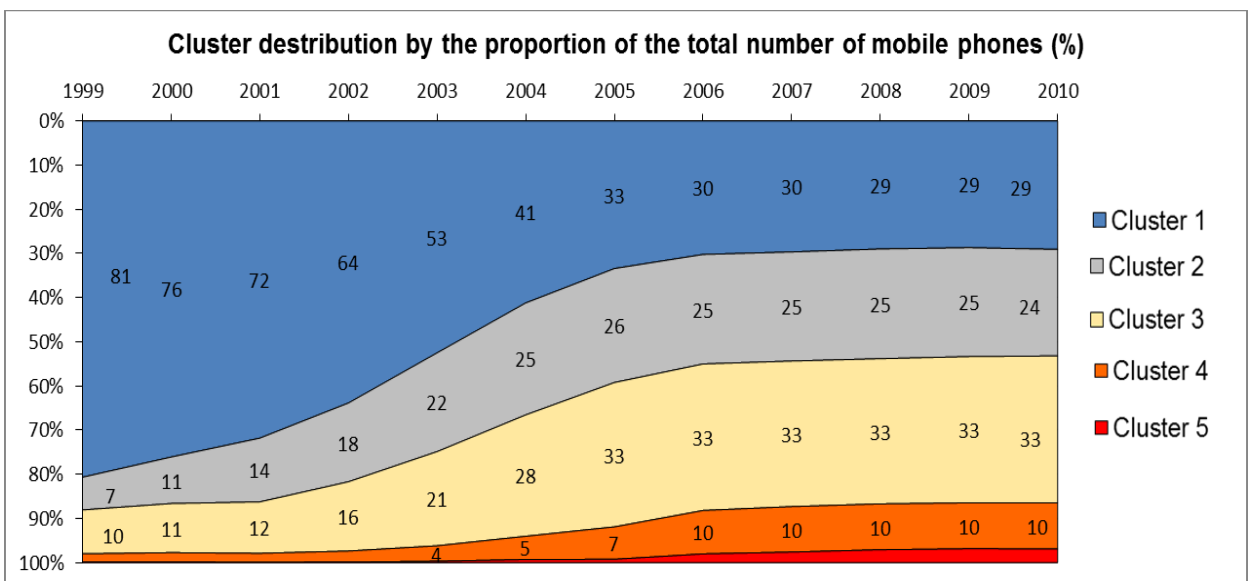


Fig. 8. Cluster distribution by percentages of active SIM cards from 1999 to 2010.

This trend is justified by the normal distribution of population in clusters (Fig. 9). Five clusters correspond to stages of diffusion by E. Rogers (Rogers, 1965), but with increased proportion of innovators. Russia is characterized by a high concentration of innovation capacity in several major regions. Rogers suggests that populations are heterogeneous in their propensity to innovate: the innovators (2.5% of adopters) go over the top first, followed by the early adopters (13.5%), followed by the early majority (34%), the late majority (34%) and the laggards in the rear (16%). These percentages are based on the normal distribution. The early adopters are better educated, more literate, have higher social status and greater degree of upward social mobility, and are richer than later adopters. The same factors are common for regions with more than 1 million people agglomerations and regions on the border with European countries in comparison with others.

The approach has a drawback: the program made the calculations itself, and it is difficult to control calculations and to interpret the results. Classification by the rate of absorption is important to understand regional capacity to adopt new technologies, but it does not show innovativeness of regional society as an ability to be the first in adoption.

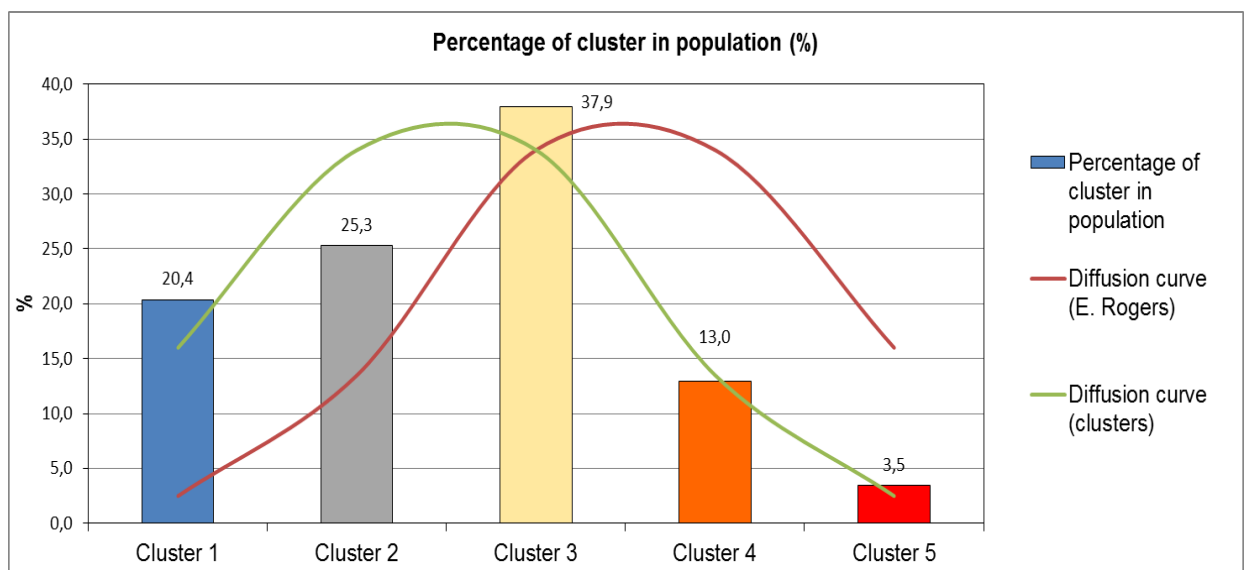


Fig. 9. Cluster distribution by percentages of the population.

The regions were classified based on ‘innovation’ and ‘imitation’ parameters for a diffusion function (Bass Model) on the same example.

An example of diffusion curve in discrete form is represented on Fig. 10. The second wave is clearly shown. The model can be very helpful in diagnostic and distinguish of latent factors (such as next wave of diffusion) and forecasting (determination of N_{max}).

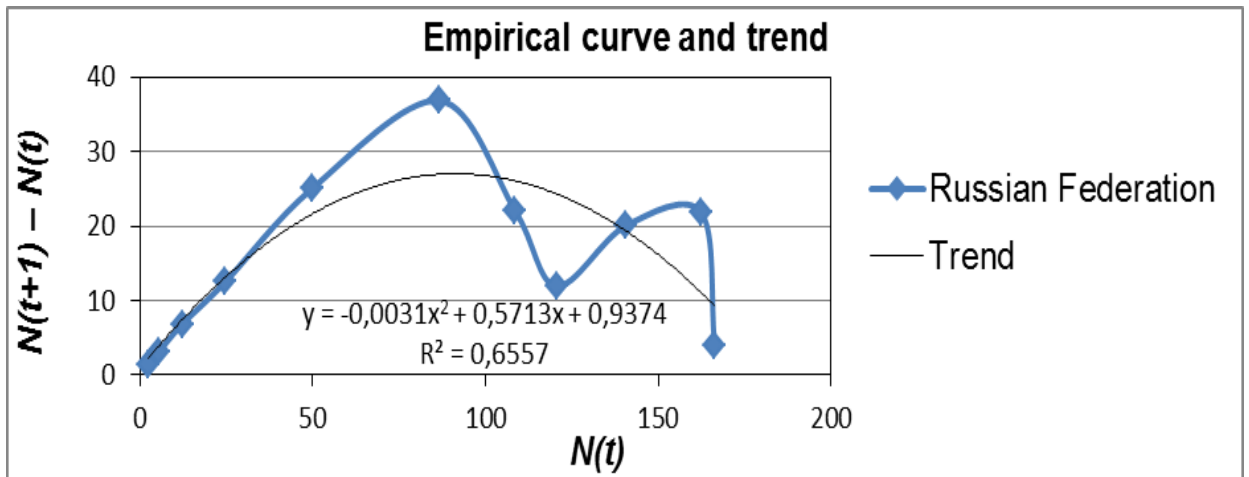


Fig. 10. The dependence between adoption rate $N(t)$ and adoption growth $(N(t+1) - N(t))$.

The presented approach showed the result of linear approximation (second-degree polynomial) above 0.66. For better results, the regions with the lowest value of the approximation ($R^2 < 0.8$) were excluded from consideration (cluster 6, Fig. 13). These are regions in which the diffusion of innovations realized relatively early, but then damped. To explain this paradox it can be hypothesized that the diffusion between different social groups was impossible for some time, or service cost was too high. After removal of these regions overall assessment of the approximation was about 0.84.

Proportions of ‘innovators’ (value of a) and ‘imitators’ (value of b) in total growth rate (‘total adds’) were established for each region to verify the model. Comparison of model and real values of total growth has led to the conclusion that our model overstates the value of the parameter a (Fig. 11). The real growth in 1999⁹ should be used for estimation of innovativeness in further calculations.

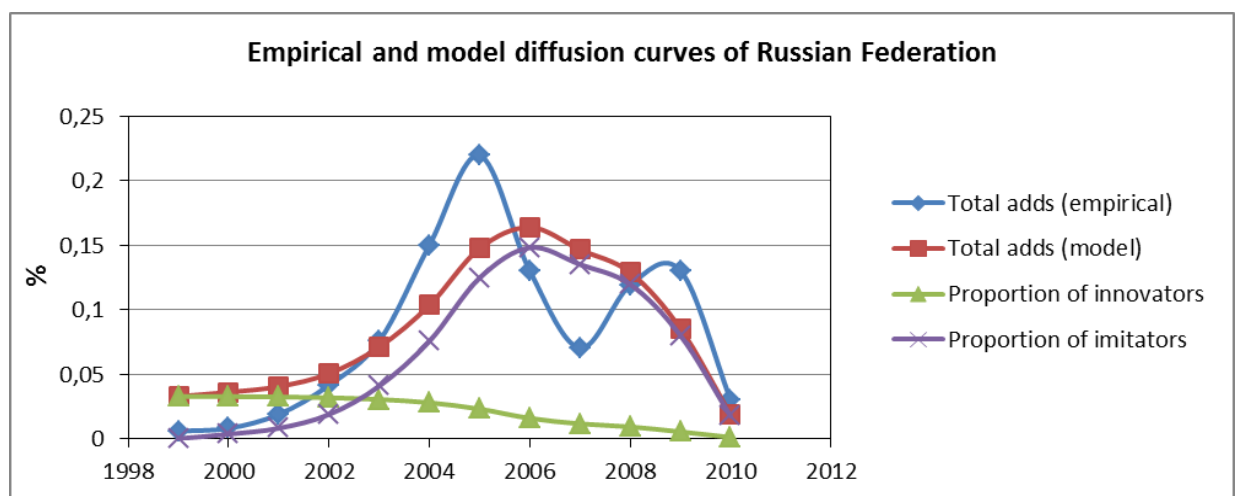


Fig. 11. Empirical and estimated curves.

⁹ All of the adopters in 1999 can be considered as ‘innovators’, because it was the first year in Russia, when mobile operators began to spread all over the country after separation and sale of GSM frequencies by the government.

The results of cluster analysis by parameters a and b are shown in Fig. 12 and Fig. 13.

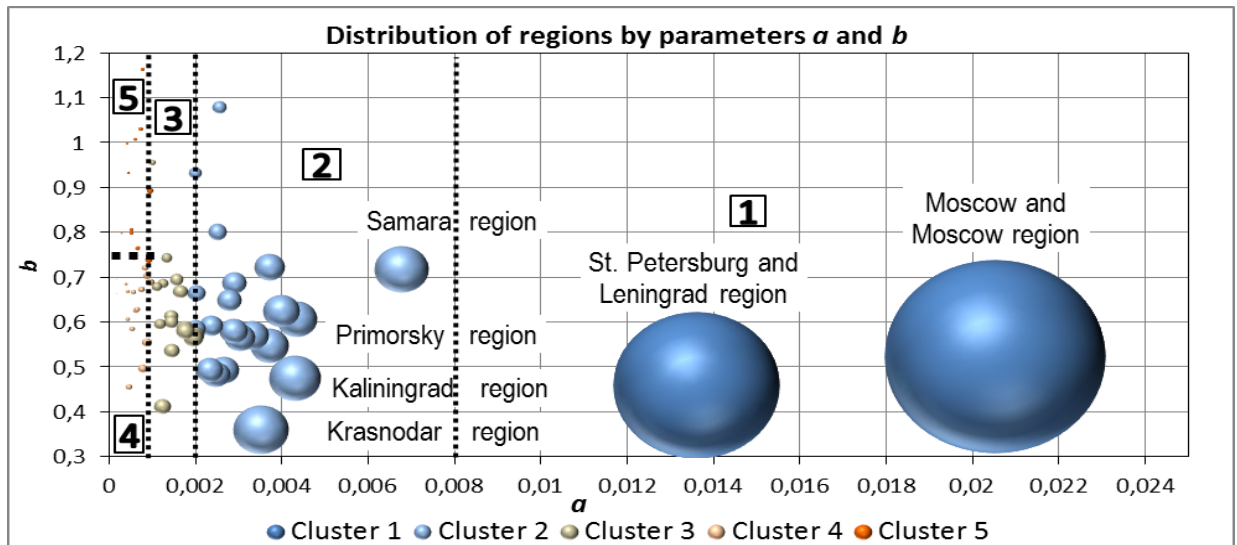


Fig. 12. Clusters of innovativeness by a and b . The size of the circle is dependent on proportion a/b .

The cluster 1 was separated by the parameter a with the value more than 0.008. It is an average value for mobile phones diffusion (Meade, 2006). The cluster consists of two Russian capitals and its suburbs. The cluster 2 was separated by an average a for Russian regions (0.002) and comprise regions with agglomerations and coastal regions. The cluster 3 consist of regions with the value of a more than 0.001, the clusters 4 and 5 were divided by an average for Russian regions b – 0.7. The 5th cluster consists of agrarian and forest industry regions. Regions with a equal to zero or which cannot be approximated by the model equation are in cluster 6. It is northern and Caucasus regions.

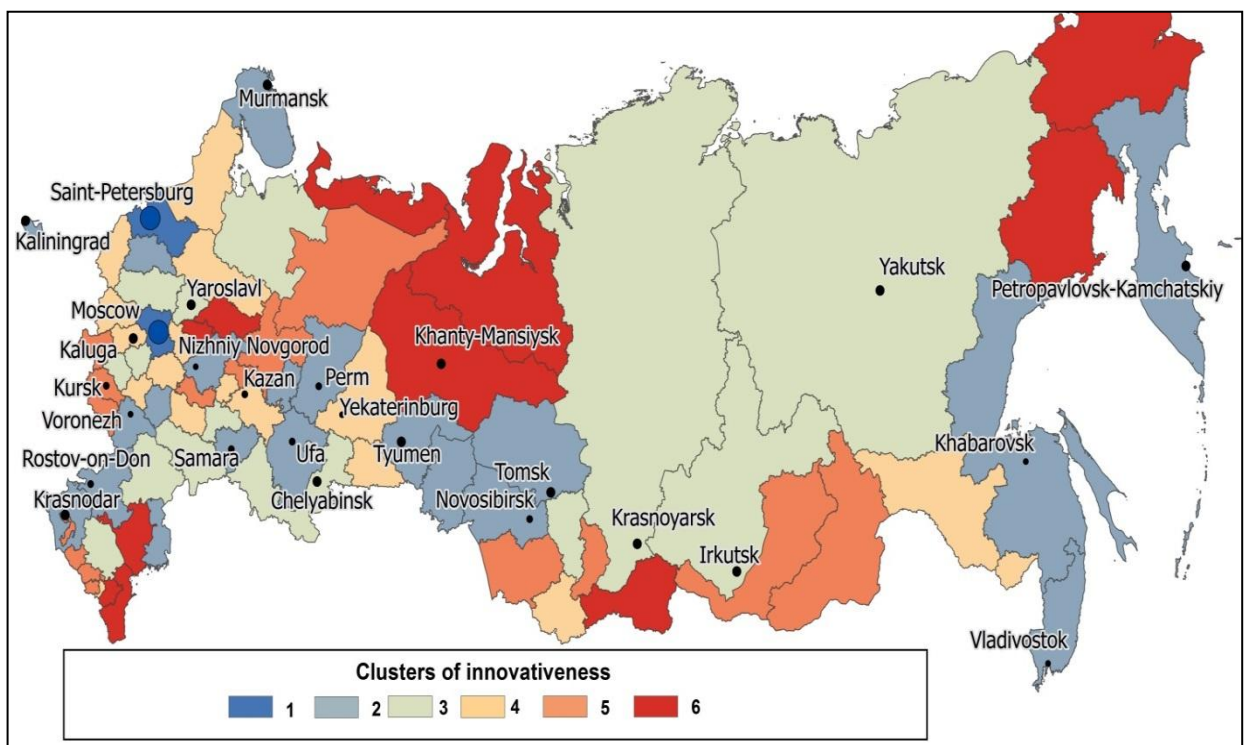


Fig. 13. Clusters of innovativeness.

The regions can be much better differentiated (in comparison with Fig. 7), but in fact by only one indicator. The classification is more sensitive to errors or extremums in time series.

3. INNOVATION POTENTIAL OF REGIONAL INNOVATION CLUSTERS

Assessment of innovation potential of regional innovation clusters includes calculation of indexes competence and interaction (fig. 14).

Network analysis, including distance matrix, helps to identify Central, North-Western, Ural, Siberian and Tyumen interregional clusters (Fig. 15). Most of the clusters are focused on the capital, so that the whole graph is a closed.

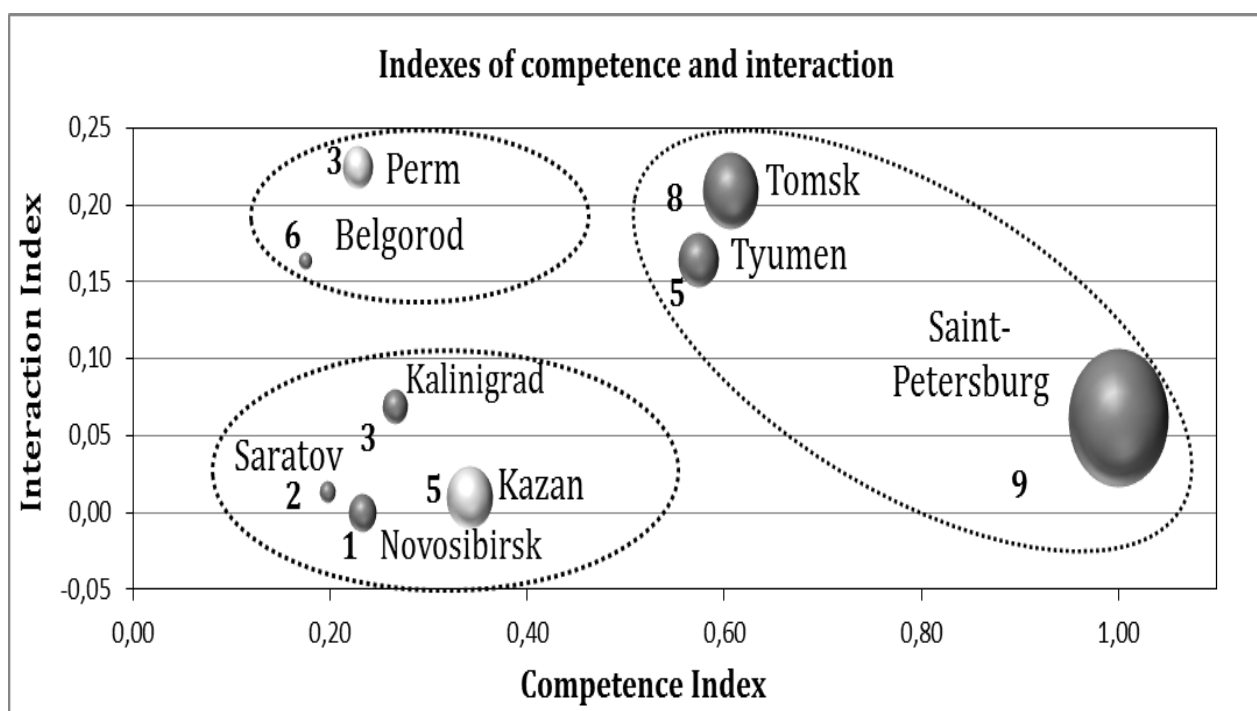


Fig. 14. Distribution of RIC between indexes of competence and interaction. Number indicates new technologies. The size of the circle depends on the number of competencies, and the white background colour indicates the absence of transfer centres

The cores of the clusters partially correspond to the previously identified major innovation centres (Fig. 5): Moscow, St. Petersburg, Tomsk, Novosibirsk, and Kazan, but the number of centres refer to region with average (Perm, Saratov) and weak (Tyumen, Kaliningrad, Belgorod) potential. If the potential of prospective markets is realized¹⁰, the emerging clusters will have a positive influence on the formation of new creative centres.

¹⁰ The market in 2020 can exceed 6 billion rubles, which is more than 6% of the Russian GDP in 2012

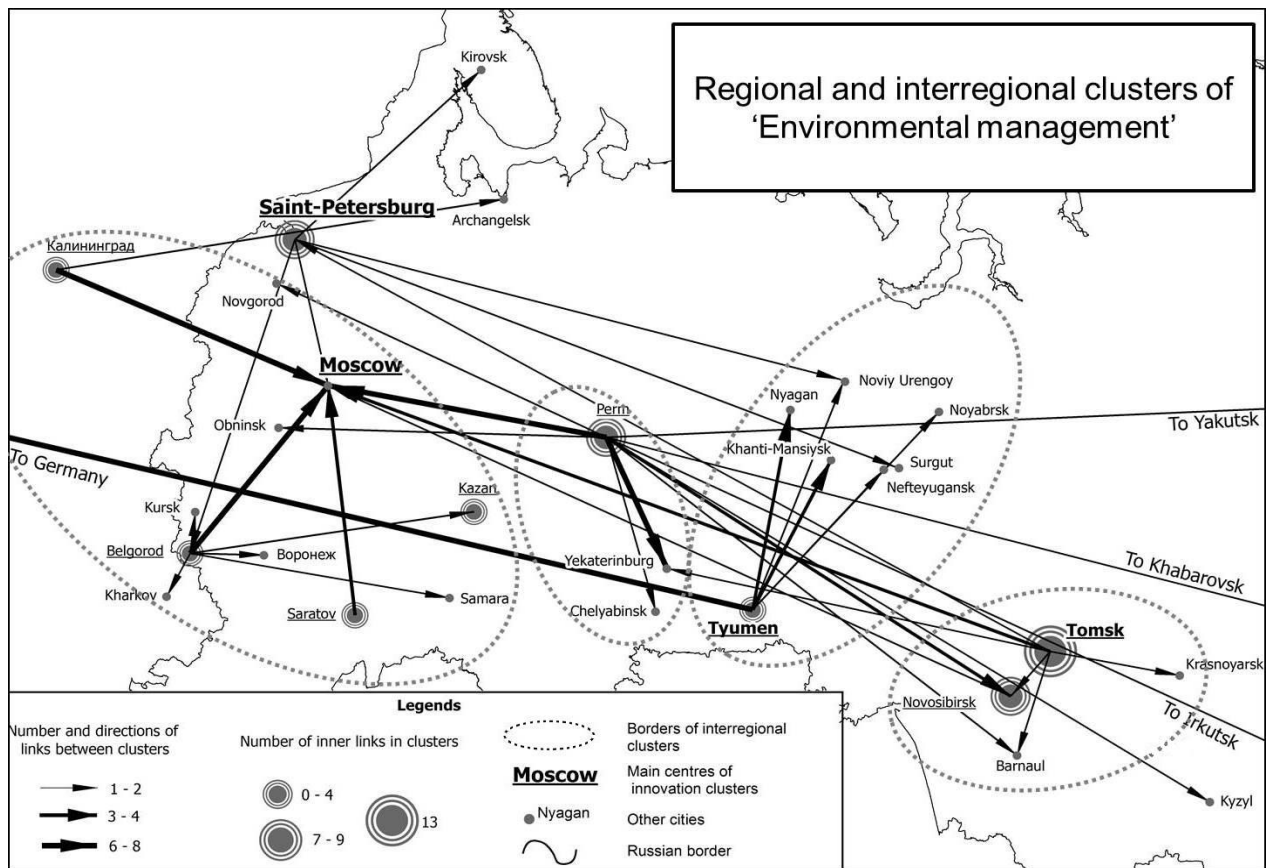


Fig. 15. Scheme of innovation collaboration between regional clusters.

The main disadvantage of the method was poor verification of experts' data. Subsequent verification was carried out by analysis of publication and patent activity of all organizations.

CONCLUSION

The work has confirmed the hypothesis of high concentration of potential in major agglomerations and research centres, including: Tomsk, Perm', and Krasnoyarsk. Russian innovation space can be described by core-periphery model: the largest cities, located in the main settlement framework, are the centres for generation and diffusion of innovation on the northern and southern agrarian peripheries. The capital region and the surrounding Volga-Oka interfluvial area have been and probably will serve in the future as a major area of innovation in Russia.

After the collapse of the Soviet Union the innovation space was divided into a number of isolated and poorly connected centres, concentration increased, variety of functions declined, and "lifeless" periphery was formed. These negative processes have not been overcome, despite the economic achievements of the 2000s. Creative activity in all northern regions is less than 5 per cent of all regions, but some arctic regions (Tomsk, Krasnoyarsk, Perm, Kamchatka kray, Murmansk oblast, etc.) characterized by a high creative potential, what can be explained by conservation of the Soviet scientific infrastructure and by initiative and mutual assistance of northern communities.

Most of the regions have the low rate of diffusion, except coastal (Murmansk oblast, Khabarovsk and Primorsky kray, Kamchatka kray, etc.). Hierarchical model of diffusion from the main centres to secondary prevails in Russia. Factor of geographical location (borderlands and seaside location) play a crucial role. At the initial stage, most northern regions have similar level of saturation (parameter a), but further absorption stops due to the low population density or institutional barriers.

More than 30% of 'Environmental management' organizations were located in the northern regions. The authors calculated an index of innovation capacity, which included the assessment of competence, new technologies and business-incubators, as well as the index of cohesion: connections and their structural and spatial diversity (Shannon's formula). Using graph theory techniques interregional clusters of the Northern Periphery (Tyumen (Tyumen) and Siberian (Tomsk)) were identified. The research shows that arctic regions are actively included in network with universities and science centres, serving as the 'field' for experiments and main consumers of new technologies.

REFERENCES

1. Asheim B., Isaksen A. *Regional innovation systems: the integration of local 'sticky' and global 'ubiquitous' knowledge* // Journal of technology transfer, vol. 27, issue 1, 2002. – pp. 77-86.
2. Baburin V. *Innovation cycles in the Russian economy*. Moscow, 2010 (in Russian).
3. Baburin V., Zemtsov S. *Innovation geography of Russia*. 2012 International Conference on Research Challenges in Social and Human Sciences, South Korea, 2012.
4. Bass F. *A new product growth model for consumer durables*. Management Science 15 (5): p. 215–227. 1969.
5. Fagerberg, J., Srholec, M. *National innovation systems, capabilities and economic development*. TIK Working Paper on Innovation Studies No. 20071024, Oslo. 2007.
6. Florida Richard. *The Rise of the Creative Class. And How It's transforming Work, Leisure, Community and Everyday Life*. New York: Basic Books, 2002.
7. Gastner M, Newman M. *Diffusion-Based Method for Producing Density Equalizing Maps*. Proc. Natl. Acad. Sci. USA 101, 2004.
8. Hagerstrand T. *Innovation Diffusion as a Spatial Process*. Chicago. 1967.
9. Isard, Walter. *Introduction to Regional Science*. New York: Prentice Hall. 1975
10. Jantsch E. *Technological forecasting in perspective*, OECD, 1967.
11. Krugman P., Fujita M., Venables A. *The Spatial Economy: Cities, Regions, and International Trade*. Cambridge, MA: MIT Press, 1999.

12. Mahajan V., Peterson R. *Models for Innovation Diffusion (Quantitative Applications in the Social Sciences)*. Sage university paper, 1985.
13. Meade N., Islam T. *Modelling and forecasting the diffusion of innovation – a 25-year review*. International Journal of Forecasting, 2006, 22. 514 – 545 p.
14. Pilyasov A., Kolesnikova O. *Evaluation of creativity of Russian regional communities // Voprosy Ekonomiki*. 2008. Number 9. P.50-69 (in Russian).
15. Rogers, E. *Diffusion of Innovations*. New York: Free Press. 1965.