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Assessment of innovation potential for Russian regions

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ASSESSMENT OF INNOVATION POTENTIAL FOR RUSSIAN REGIONS

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Abstract

Innovation development is declared as one of the key objectives of social and economic policy in Russia. The purpose of the work was to identify regions with the highest innovation capacity and developed regional innovation system, where support of innovation activities would be the most effective. The hypothesis was that innovation capacity can be expressed as a probability function, which dependent on density and concentration of innovators and intensity of their interaction.

Taking in account the hypothesis, gravity model of patent activity per capita was used to estimate creative potential of Russian regions. Patent activity in Russia declined significantly from 60000 granted patents in 1989 to 22500 in 2012. The largest cities and closed science cities are still the sources of new technologies, but activity in the Moscow core decreased from 230 to 30 patents / 100 thousand residents in 1999.

Patents are not innovations in the full sense of the term, because they may not be implemented. Most of approaches for innovation capacity assessment in Russia based on index compilation and have several disadvantages: correlation between indicators, non-normal distribution of indicators, etc. Considering the disadvantages the author collected a database of 38 indicators of innovation sphere, and conducted normal distribution, correlation and factor analyses.

The indicators of the first factor 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 (%), number of university students per 10 thousand people; percentage of employees in R & D sector in total employment (%); number of registered patents per 1000 employees; percentage of organizations with a website (%).

Six groups of regions were identified: 'innovation core' (index = 1 – 0.7); 'highly developed' (0.7 – 0.6); 'regions with a strong science sector' (0.6 – 0.5); 'regions of basic sectors of the economy' (0.5 – 0.4); 'regions with limited potential' (0.4 – 0.3); and 'peripheral regions' (less than 0.3).

To prove the correctness of the chosen indicators logit-regression between the index and international PCT-applications was made. The regression results are compared with the results for other existing indexes. The probability of new technology generation in Moscow among all regions close to 1, and it is close to zero in Chukotka. The work has confirmed the hypothesis of high concentration of potential in major agglomerations and research centres.

Keywords: geography of innovation, patent activity, Russian regions, innovation potential of regions, factor analysis.

INTRODUCTION

Innovation development is declared as one of the key objectives of social and economic policy in Russia, however, national innovation system has been highly degraded since 1990. Attempts to recreate an effective system by establishing state corporations and innovation cluster 'Skolkovo' have not led to significant changes. Meanwhile, support of

activity in the most favourable localities, especially in large cities and innovation clusters, becomes one of the most urgent issues.

Innovation potential is the main objective of the study. It is a combination of conditions and factors, which could maintain and increase generation and dissemination (or absorption) of innovations. The potential is polarized and heterogeneous. The high concentration is common for regions with operational regional innovation system (RIS). RIS is an infrastructural, institutional and organizational embodiment of innovation cycle stages in its classical meaning: "idea", "novation", "innovation", "finished product", "consumed innovative product" (Asheim, 2002; Doloreux, 2005). Then the main subsystems are infrastructure (technological, organizational, financial, etc.), educational and scientific organizations, technology transfer centres, innovative business and its consumers.

The purpose of the study was to identify regions with the highest potential, where support of innovation activities would be the most effective. Different geoinformational and statistical methods (classification, cluster analysis, scaling, etc.) were used. The study included three different in scope and methodology phases.

On the first stage creative potential was studied. Patent activity was explored with the help of gravity model. Two complex indices have been applied. Using expert interviews and factorial analysis main factors were identified; integral rating was used to classify regions.

Analysis of foreign theoretical and applied research of innovative processes (Cooke, 1992; Asheim, Isaksen, 2002; Tödtling, Trippel, 2005; Synergy space ... 2012) shows that one of the elements of effective support for innovative activity is formation and development of regional innovation systems. The policy states seeks to identify and support areas with greatest potential.

To evaluate the effectiveness of innovative systems a number of ratings used abroad, characterizing conditions and results of innovation (Cooke, Gomez Uranga, Etxebarria, 1997; Carlsson, Jacobsson, Holmén, Rickne, 2002; Doloreux, 2002; Fritsch и др., 2002; Doloreux, Parto, 2005; Zabala-Iturriagagoitia, Voigt, Gutiérrez-Gracia, Jiménez-Sáez, 2007; Hollanders, Tarantola, Loschky, 2009; Brenner, Broekel, 2011; Innovation Union Scoreboard 2011, 2012). Most of the indicators are used in modern Russian rankings with modifications according to the Russian statistical service (Rating of innovation development, 2012).

CREATIVE POTENTIAL OF RUSSIAN REGIONS

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). Gravity models (Izard, 1975; Krugman, 1997), which describe ‘power’, or ‘field’, of objects and distance between them, can be used to evaluate creative potential in the first approximation.

‘Field of potential’ method was used to estimate potential (V_j) of different cities in the USSR in 1989 and in modern Russia. The following equation (Eq. 1) of potential field was applied:

$$V_j = P_j + \sum P_i / D_{ji}, \quad (1)$$

where P_j is a value of an indicator (number of granted patents per 100 000 urban citizens) in point j , P_i is a value of the indicator in a point i ; D_{ji} is a distance from a point j to a point i , km.

To assess the degree of territorial differentiation (diversity) of innovation activity between regions the Shannon entropy index was used (E)

$$E = \sum S_i \times \log(1/S_i), \quad (2)$$

where S_i - a percentage of granted patents in a region i of the total number of granted patents in Russia.

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. The results of studies in 1989 (Baburin, 2009) and in 2010 were compared (Fig. 1).

Innovation "core" is mainly concentrated in the multifunctional urban agglomerations¹: 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.). External innovations are used more actively in the regions in comparison with the Soviet period.

¹ Indicator of the proportion of people employed in R & D of the total employment was used for verification; both indicators form close spatial structures.

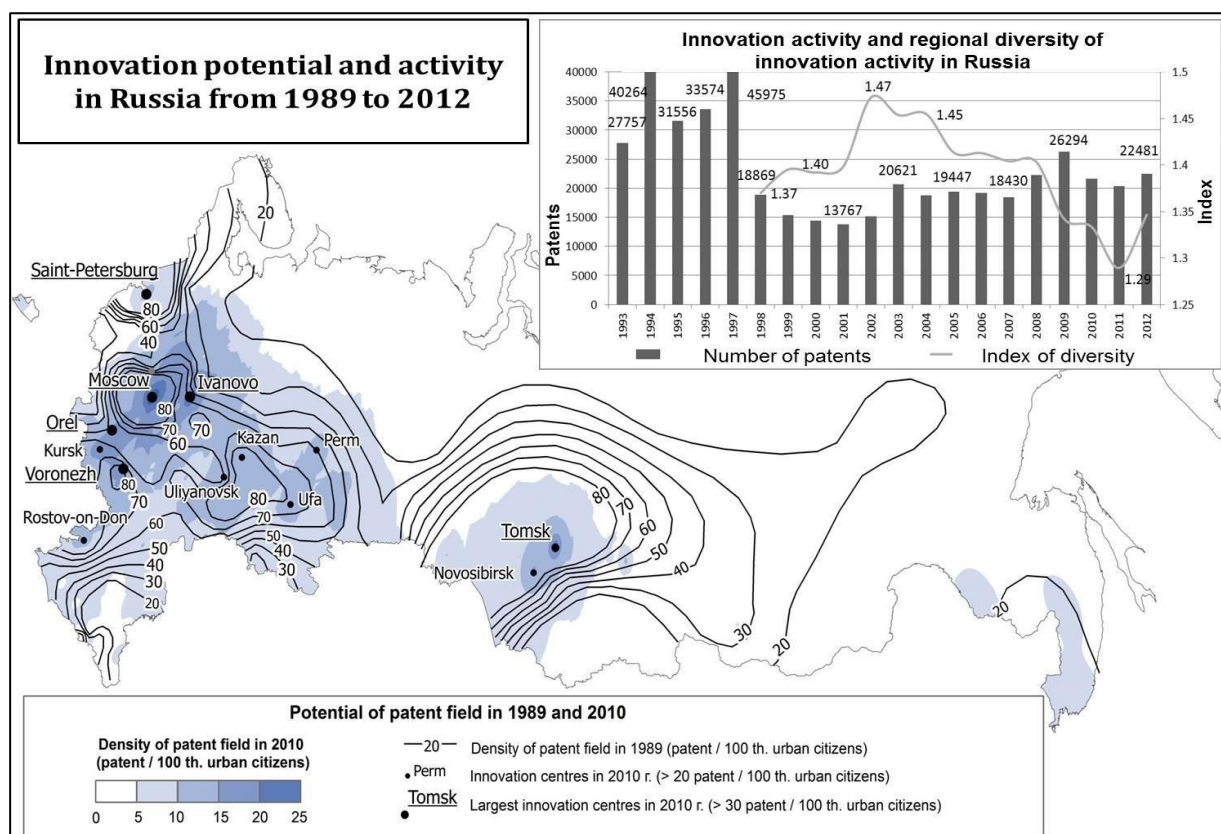


Fig. 1. Comparison of patent field potential in 1989 and 2010. The inset shows dynamics (from 1994 to 2012) and the index of regional diversity (from 1998 to 2012) of patent activity in Russia)

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 1989². 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.

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%. Diversity index (E) fell from 1.47 in 2002 to 1.29 in 2011. The cartogram³ of patent activity (Fig. 2) demonstrates the level of polarization. The size of polygons (region borders) was changed, so that it matches the corresponding absolute indicator (the number of patents).

² 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.

³ 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

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.

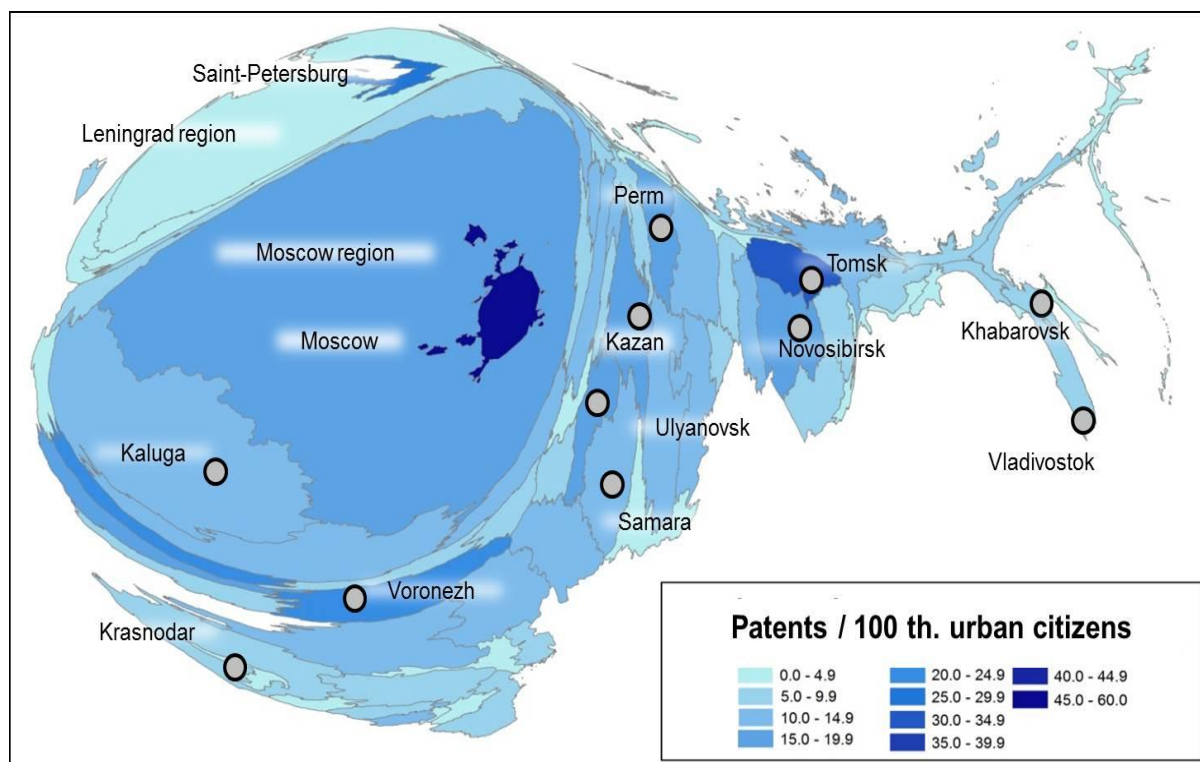


Fig. 2. Cartogram of patent activity in Russian regions in 2010

The official Russian statistics (from the Federal State Statistics Service) is not perfect because of lack of uniform and clear standards in innovation sphere⁴. 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.

⁴ 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.

INNOVATION POTENTIAL

Considering the disadvantages of previous methods the author has 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.

Table 1. Indicators of innovation potential

Socio-economic space	1.1. Economic-geographical position (capital, agglomeration, coastal area)
	1.2. Population density
	1.3. Percentage of urban citizens (urbanization)
	1.4. Percentage of population in cities with more than 200 th. people
Territorial socio-economic system	Technological sphere
	2.1. Percentage of ICT expenditure in GDP
	2.2. Computers per capita
	2.3. Computers with Internet per capita
	2.4. Percentage of organizations with web-site
	2.5. Percentage of organizations with special programs
	Economic sphere
	3. GDP per capita
	Social sphere
	4.1. Percentage of people with high education
	4.2. Migration per capita
	4.3. Percentage of foreign migrants
	Cultural sphere
	5.1. Percentage of households, where members are of different ethnic group
	Informational sphere
	6.1. Percentage of Internet users
Regional innovation system	Education
	7.1. Number of university students per capita
	Science
	8.1. Number of scientists per capita
	8.2. Number of registered patents per 1000 employees
	Transfer (R'n'D)
	9.1. Percentage of employees in R & D sector in total employment
	9.2. Percentage of R'n'D expenditure in GDP
	9.3. Percentage of R'n'D organizations
	Production
	10.1. Percentage of technological innovations expenditure in GDP
	10.2. Number of new technologies per 1000 employees

	10.3. Percentage of innovation active organizations
	10.4. Innovative production percentage in total production
	Consumption
	11.1. Service access to information via the Internet, GB per year per urban citizen
	11.2. The number of registered mobile subscriber terminals per capita

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: 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 index points to preconditions of innovative processes, otherwise it expresses the probability of innovation origin (Fig. 3). Moscow is the largest innovation centre with an integral index equal to 1. Then we can assume that the probability of innovation appearance in Moscow among all regions close to 1, and it is close to zero in Chukotka region.

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.

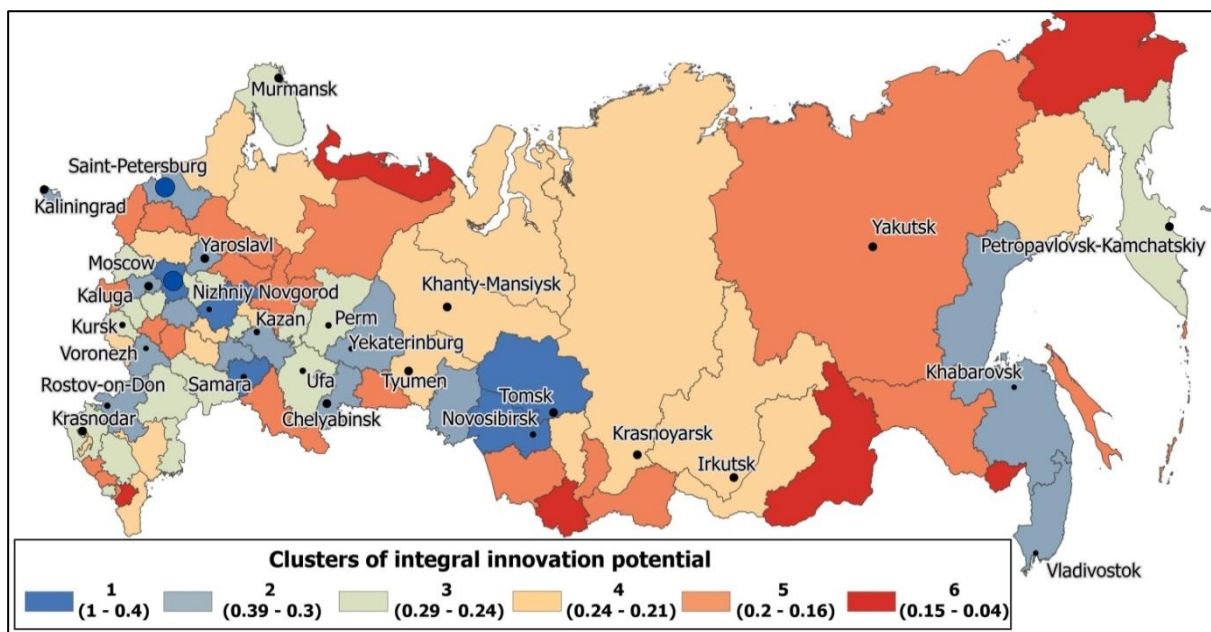


Fig. 3. Index of regional innovation potential in 2010

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. Nevertheless, the high level of correlation between three indexes indicates the validity of the results. Moreover, the distribution of regions by the last index is the closest to normal. The index can be used to conduct regional policy, allocation of foreign innovative company research centres, etc.

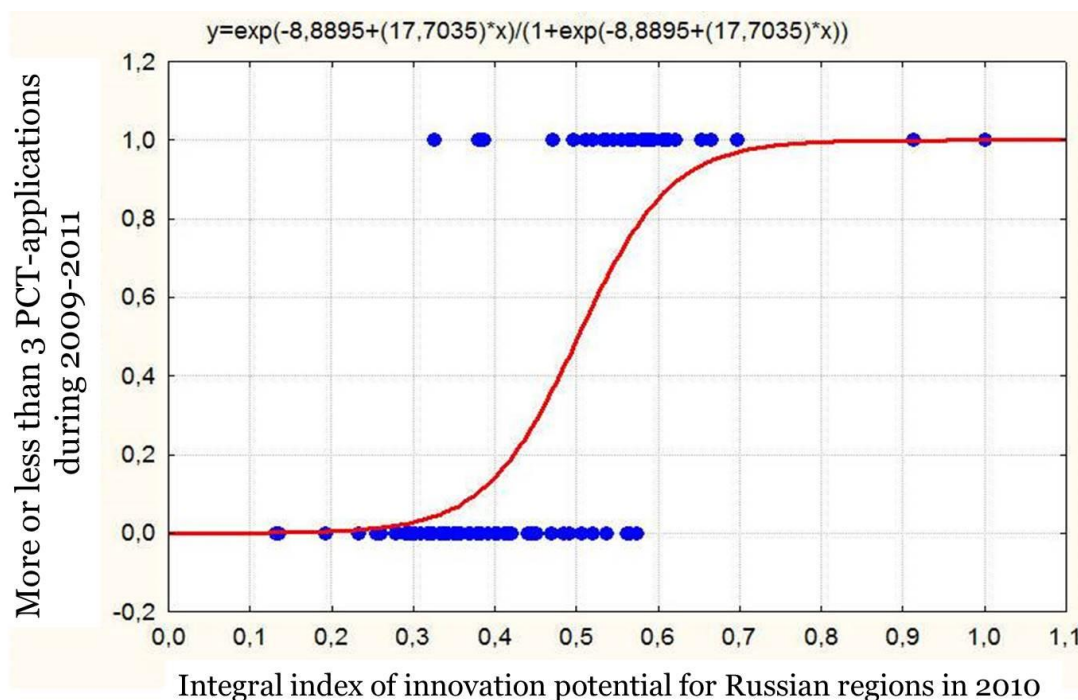


Fig. 4. Connection between the index and the probability of new technology emergence

To prove the correctness of the chosen indicators logit-regression between the index and international PCT-applications was made (Fig. 4). PCT-application can be used as an indicator of new technology emergence.

CONCLUSION

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.

The study revealed the regions with the highest and lowest potentials to create innovations and perspectives to support regional innovation systems.

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