The European Proceedings of
Social & Behavioural Sciences
EpSBS

Future Academy

ISSN: 2357-1330

https://dx.doi.org/10.15405/epsbs.2019.03.136

GCPMED 2018
International Scientific Conference "Global Challenges and Prospects of the Modern Economic Development"

EMPLOYMENT IN INNOVATION PRODUCTION NETWORKS: REGIONAL SAMPLE

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Abstract

The research deals with the challenging issue related with the need to analyse the current stage of employment differentiation in innovation production networks on the regional level. The aim of the paper is to study the status and trends of employment development in innovations sector using the clustering method. The results of research: We have distinguished five regional clusters for the year 2016, featuring different combinations of potential and actual employment parameters within the innovation production sector. The results can be used in the development and management of the regional innovation and employment policies. The applied methodology allows for continuous monitoring of the employment system in the regional innovation production networks, identifying intercluster interactions, and account for the changes in innovative employment. The proposed approach to clustering the employment regions in innovation production networks allows for an appropriate assessment of the employment rate, determine the key factors in forming innovation vectors of the regional development, and substantiate effective regional innovation and employment policies. Innovations should become a starting point and a stimulus for using the mechanisms of regional self-development. The objectives relating productivity growth can be realized only under mainstreaming innovations, which in turn is determined by the efficiency and quality of employment rate in this area.

Keywords: Employment, innovative activity, innovative sphere, labor costs, regions, regulation.

https://dx.doi.org/10.15405/epsbs.2019.03.136
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Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

1. Introduction

In present-day conditions, it is the regions that become independent entities of innovation processes. The research shows that the present-day employment environment in innovation networks on the regional level presents a real mosaic. Specific globalization processes have a debatable affect on innovation processes in the various regions of Russia and deepen the existing asymmetry in the employment sphere.

When investigating employment problems in innovation production sector in the regions, we can highlight several vectors, which include the following: investigations of the Russian and foreign scientists, where the emphasis is placed on significance of intellectual capabilities of an individual (Simonova, Kolesnikov, & Karakova, 2018); analysis of the "knowledge" component in the economy; the study of innovations in terms of the various effects on employment growth in the long term perspective (Vivarelli, 2014; Harrison, Jaumandreu, Mairesse, & Peters, 2008); the problems of spatial localization of innovations and development of regions due to advantages in the “production of new ideas” sectors (Carlino & Kerr, 2015); The issues of generating innovations on the level of firms is being investigated by the foreign authors (Bogers, Foss, & Lyngsie, 2018); the mechanisms of innovations development in the Russian regions.

2. Problem Statement

Specific character of employment dynamics in innovation production networks implies a clear definition of their boundaries. The innovation production sector is rather heterogeneous. It includes the sectoral and academic research institutes, higher education institutions conducting research, specific innovation structures (technology parks, technopolis parks, business incubators, technology transfer centers), industrial enterprises engaged in designing new products and marketing these products, non-institutionalized bodies (entrepreneurs, and inventors engaged in private R&D and inventive activities).

Analysis of the problems of spatial employment asymmetry in innovation sphere is becoming serious due to the following aspects: insufficient quality of regional innovation statistics, its non-transparency, confidential nature and insufficient assurance; insufficient development of a range of complex parameters; and underestimation of employment problems in the given area in the process of its management, etc. In the further study of these issues, we should take into account a number of aspects. First, development of the digital economy reveals insufficiency of traditional measures and methodologies for estimating the results of innovation activities (such as patent activity) (Baller, Dutta, & Lanvin, 2016).

The data provided by the foreign researchers show the discrepancy between the patent activity and the estimated innovative potential of companies. Second, the nature and practices of labour and employment are constantly changing. Third, we are facing new priorities in innovation and industrial policies, and their effect on the regional level. One of the key vectors in the industrial policy of Russia is “formation of a set of measures which must ensure the acceleration of import substitution processes across a wide range of areas" (Kondratiev, 2014, p.26). Additionally, there are other priorities which imply development of high-tech and medium-tech types of industries in the regions considered as leaders in innovations.

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The heterogeneous character of the regional employment environment in innovation production networks in terms of various indicators raises a range of research and managerial problems.

3. Research Questions

The problem of regional employment asymmetry in innovation area, and designing the measures to manage the given process remain understudied.

In order to identify homogeneous groups of regions in terms of employment parameters in innovation sphere, it is important to cluster the regions by a set of indicators. Analysis of the clusters in terms of time parameters will reveal the nature of intergroup relocations.

It is important to ensure not only funding to the urban infrastructure of Science Cities, but rather stimulate innovative activities in the area. The experience of Dubna, Obninsk, Koltsovo and other Science Cities shows that even small state funds directed to innovation projects, in case of competent policies, can attract greater resources from non-governmental institutions.

4. Purpose of the Study

The aim of the given research is to analyse the regional employment asymmetry in innovation production networks and identify the incentive measures required for this employment area.

5. Research Methods

Selection of the clustering criteria is based on the analytical experience. As the basis for clustering, we chose the following criteria: a) employment potential in innovation production sphere (number of students per 10,000 people) (H); b) the actual employment figures (the share of R & D personnel in the total number of employees) (D); c) the cost of labour per 1 employee engaged in R & D (W); d) the “output” indicators, employment performance in innovation sphere (innovation activity of an organization) (I).

We can consider the number of patents and security documents issued, in order to demonstrate the performance results in this area. However, we assume it is necessary to use a much common indicator. Including such indicators as graduation from doctoral and postgraduate courses of study, the number of researchers with scientific degrees, issue of security documents and patents do not provide significant changes into the picture of classifying regions by clusters. For calculation purposes, we used the standard values for the selected indicators and the K-means clustering method. We did not take into account the regions where there was no data. The characteristics of cluster centres existing in 2016 are presented in table 01.

According to the results of analysis, we obtained five clusters of the regions characterized by different levels and potential for the development of employment in innovation production networks.

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Table 01. Cluster Centers (2016)

Indicator	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
I	0,470762	0,592011	0,21864	0,2566	0,285883
ChS	0,645279	0,477077	0,37112	0,303009	0,37637
Z	0,546597	0,276335	0,215665	0,779886	0,460537
D	0,836622	0,133221	0,070748	0,133006	0,200805

Note: Developed by the authors using the data of the Federal State Statistics Service (Analytical Statement, 2018)

Let us consider the substantive aspects of the defined clusters. The first cluster is characterized for a high proportion of R & D personnel in the total number of employed in the region, above the average rate of innovation activity and the number of students per 10,000 people, and the average rate of payments for R&D staff.

The regions of the second cluster are distinguished for the highest rates of innovation activity, the average rate of students per 10,000 people, lower than average labour expenses, and small proportion of R & D personnel in the total number of employees.

The third cluster includes the regions with the highest labour costs of R & D employees, indicators of innovation activity, and the number of students per 10,000 people is below the average values.

The regions of the fourth cluster are characterized for innovative activity, the number of students per 10,000 people being below the average rate, the average level of expenses for R&D personnel, and the growing dynamics of a small share of R & D personnel in the total number of employees.

Within the framework of the fifth cluster, we included the regions having the least favourable situation in terms of all the indicators below the average values.

Table 02 presents the data on the composition of clusters in 2016.

Table 02. Composition of regional clusters in terms of employment parameters in innovation production networks in 2016

Cluster	2016
1	Kaluga Region, Moscow Region, Moscow, St. Petersburg, Nizhny Novgorod Region, Novosibirsk Region, Tomsk Region
2	Belgorod Region, Voronezh Region, Lipetsk Region, Ryazan Region, Tambov Region, Rostov Region, Republic of Mordovia, Republic of Tatarstan, Chuvash Republic, Penza Region, Altai Territory
3	Bryansk region, Kursk region, Oryol region, Vologda region, Kaliningrad region, Pskov region, Republic of Adygea, Republic of Kalmykia, Republic of Crimea, Krasnodar region, Astrakhan region, Volgograd region, Sevastopol, Republic of Dagestan, Kabardino-Balkar Republic, Karachayevo Circassian Republic, Republic of North Ossetia - Alania, Chechen Republic, Stavropol Territory, Republic of Mari El, Udmurt Republic, Orenburg Region, Saratov Region, Kurgan Region, Republic of Altai, Republic of Tyva, Republic of Khakassia, Trans-Baikal Territory, Amur Region
4	Smolensk Region, Komi Republic, Arkhangelsk Region, Murmansk Region, Tyumen Region, Krasnoyarsk Territory, Kemerovo Region, Sakha Republic (Yakutia), Kamchatka Territory, Sakhalin Region
5	Vladimir region, Ivanovo region, Kostroma region, Tver region, Tula region, Yaroslavl region, Republic of Karelia, Leningrad region, Novgorod region, Republic of Bashkortostan, Perm region, Kirov region, Samara region, Ulyanovsk region, Sverdlovsk region, Chelyabinsk region, Republic of Buryatia, Irkutsk Region, Omsk Region, Primorsky Territory, Khabarovsk Territory, Magadan Region

Note: Developed by the authors using the data of the Federal State Statistics Service

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Analysis of the composition of clusters within the examined period allows us to state the following:

a) The smallest is the first cluster, which is traditionally represented by the leaders in innovation employment (large agglomerations, industrial and scientific centres). Thus, more than 30% of Science Cities are located in the Moscow region with more than 55% of scientific centres in the Russian Federation. Then are the Urals followed by the Western Siberia (Altai Territory, Novosibirsk and Tomsk Regions).

b) In 2016 the largest part of the regions is concentrated within the 3rd cluster (29), which is distinguished by high payments to R & D staff. It should be noted that some regions have rather stable positions in this cluster (particularly, Kaliningrad, Saratov and Astrakhan regions, the Republic of Dagestan, Khakassia, and others).

This cluster is characterized for its heterogeneity. A combination of high salary characteristics - low innovative activity and low employment in R & D demonstrate an inefficient model of employment in innovation production. Comparing the situation in the cluster composition in 2011 and 2016, we must notice that in general, the number of regions with problems relating indicators has increased over the same period, which requires taking into account the labour component in innovation development programs and plans for modernizing the enterprises in these regions. In particular, our calculation results confirm the fact that, in spite of significant changes in the level of innovative activity in Russia, primarily due to the growing state support of research and developments through the grant system and other types of financial support, and investments targeted to commercialize the innovation projects are insufficient, which leads to low indicators of innovation activity (Baev & Solovyova, 2014).

In 2016, compared to the previous period, the 4th and 5th clusters demonstrate the growing share of employed in R&D sphere accompanied by the high rates of average R&D labour costs. As the results of our research show, among the leading regions in terms of employment in the innovation sphere, there are regions with high number of research centres, knowledge-based industrial enterprises engaged in mechanical engineering, chemistry, defence industry, composite materials, biotechnologies, etc.

The results of the research confirm the conclusions on heterogeneity of the regions in terms of innovative development parameters. In the majority of cases, high values relating one block of parameters correspond to the low values of the other block, or we can observe significant deviations relating one or several sub-indexes.

The ranking of the entities of the Russian Federation in terms of scientific and technological development index shows that of Moscow, St. Petersburg and the Republic of Tatarstan are at the top of the ranking. The top positions of the two capitals are due to historically high level of science and technologies development, clustering of the leading research institutes and mega universities, and substantial funding. Judging by the Index, the Moscow region, Perm region, Sverdlovsk region, Tula region and Tomsk region are also among the top ten entities.

The key vectors of extending employment opportunities in innovation sphere on the regional level are set by the vectors of innovation development within the regional social and economic systems. In particular, the drivers of innovation development in the Middle Urals are the following: the research and development sector, the military industrial complex, civil engineering industries, mining and smelting

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enterprises, the chemical and pharmaceutical industry, development of innovation infrastructure, import substitution used to enhance innovative development in the region, territorial aspects of industrial policy in the region, and staffing of innovation development of the industry (Kondratiev, 2014).

The developed typology allows us to complement the existing typologies (developed in line with the criteria of socio-economic status, and criteria of innovation), which creates a comprehensive and multidimensional picture of asymmetry of economic and innovation environment in the regions of Russia, with account for import substitution strategies and industrial policy guidelines. Judging by these criteria, the Moscow, St. Petersburg, Nizhny Novgorod, Tomsk, and Novosibirsk regions are at the top of the ranking. However, within the given cluster, there are discrepancies between the indicators of the regions.

Analysis of the data characterizing the quantitative aspect of innovation structures (such as Science Cities, technology parks, regional venture funds, business incubators, special economic zones, etc.) and the staff employed in these institutions allowed us to testify a significant gap between the Central Federal District and other districts in terms of employment indicators referring the Science Cities and technology parks. According to the data of the Ministry of Industry and Trade, more than half of technology parks are located in the following federal districts: the Central Federal District (35), the Volga Federal District (9), and the Urals Federal District (8). In fact, the key components of operational efficiency of technology parks in Russia are their proximity to the major research centres and favourable academic environment, investments made by private individuals, and a keen interest of the local authorities in diversification of the economy.

Judging by the number of business incubators, the Volga Federal District, including the Southern and North Caucasian Federal Districts are among the leaders. Special economic zones are located mainly in the Siberian Federal District. Thus, we can testify that the spatial structure of employment in innovation sphere and its structure relating certain types and forms of innovation activity overlap.

It would be appropriate to analyse the relationship of classifications of the regions in terms of employment parameters in the innovation networks and innovation indicators. According to the rating of the Higher School of Economics, the Russian Regional Innovation Index (RRII) consisting of 37 indicators in 2015 and classified under four thematic groups, the top three leaders in the rating of innovative development over a number of years remain the same (Republic of Tatarstan, Moscow and St. Petersburg).

The ranking of the entities of the Russian Federation by the priority of the elements of the innovation system, which ensure development of high-tech and medium-tech industries of high quality (as of 2014), according to expert estimation, included the first five regions: Moscow, St. Petersburg, Moscow Region, Republic of Tatarstan, Samara Region, Nizhny Novgorod Region, Sverdlovsk Region, Perm Territory, Kaluga Region, and Chelyabinsk Region. The mission of these centres is to generate an engineering and technological platform for the development of domestic high-tech industries and expand the Russian segment on the markets of high-tech products and services (Suhovej & Golova, 2016).

The conclusions made by the researchers are the following: the regions of Russia are characterized by uneven development of various aspects of innovation processes and factors affecting these processes; the hypothesis relating interrelation between the balance of various aspects of innovative development of the regions and their success in the ranking has not been confirmed; coordination in the area of innovation

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development on the part of government bodies, companies, universities and scientific organizations has a long-term effect; inconsistent policy of the regional government authorities enhances volatility of the status of a region in the ranking, but does not empower its sustainable development; territorial classification of the regions with different levels of innovation growth can be characterized as stable though uneven.

6. Findings

The conducted clustering of the regions in terms of employment in innovation networks shows that the policy aimed at to empower innovation employment must be selective and take due account of the features specifying the distinguished groups of the regions. In order to realize innovation potential of the outsider regions, it is necessary to encourage the growth and efficiency of employment in innovation sphere, as well as domestic demand for innovations both within and outside these regions. The federal and regional innovation development programs play an important role in upgrading the employment rate in the given area. These programs are targeted to increase the number of organizations involved in development of advanced technologies and upgrading efficiency of existing organizations. The challenging issues are remuneration conditions in innovation sector, and facilitating innovative potential of human resources in the regions.

A further study of this problem will cover the findings related with the following aspects: find out if the innovation sphere can generates job placements in the regions; what type of activities in the given area are most attractive for employees. Regulation of employment in innovation sphere across the regions in Russia requires development of clear-cut conceptual approaches, improvement of the monitoring data base, forecasting the changes in employment, improving flexibility and targeting of the regulation procedure (Sankova & Mirzabalaeva, 2018), and using a range of regulatory measures (with the focus on economic measures).

Regulatory measures, and in particular, innovative incentives, taxes and entrepreneurship, technology transfer play an important role in expanding innovation activity. The current innovation policy in the EU countries is based on delegating differentiated authority to the regions within the framework of the concept of smart specialization (McCann & Ortega-Argilés, 2015; Camagni & Capello, 2013). This approach implies the development and implementation of the regional innovation strategies, which determine priorities in the development of every region based on its competitive advantages and relevance of scientific and technological developments to the needs of the business.

7. Conclusion

The proposed approach to clustering the employment regions in innovation production networks allows for an appropriate assessment of the employment rate, determine the key factors in forming innovation vectors of the regional development, and substantiate effective regional innovation and employment policies.

In our further research, we are planning to resolve the following issues:

- in line with the methodology worked out by the authors, identify the main trends in the development of regional labor markets within the period of 2017, and consider the dynamics of innovative development of the regions;
- identify the relationship and interdependence between the innovation component and productivity growth in the regions;
- estimate effectiveness of the state regional policy in encouraging susceptibility to innovations and activity of the regions.

Innovations should become a starting point and a stimulus for using the mechanisms of regional self-development. The objectives relating productivity growth can be realized only under mainstreaming innovations, which in turn is determined by the efficiency and quality of employment rate in this area.

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