REGIONAL INNOVATION SECURITY: A DYNAMIC APPROACH TO NEW CHALLENGES FOR THE WESTERN BORDERLAND OF RUSSIA

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Abstract

The article provides the review of existing approaches to indexation of regional innovation security, as its relevant diagnostics is the urgent issue for the regional development and competitiveness. Based on the results of the review and comparative analysis, the research identifies the possibilities to use various approaches in the current situation of Western Russian border regions suffering from the cross-border disintegration in the conditions of resent geo-economic changes. Summarizing the existing indexation systems and modeling the processes of regional innovation development and competitiveness, the authors generate the new approach based on the concept of the complex multi-scale regional innovation cycle. The proposed methodical set is aimed to make the diagnostics of regional innovation security be relevant in the current situation of Western Russia. The theoretical concept is verified with the empirical evidence on innovation indicators of the Rostov region and Kaliningrad region as the examples of Western border regions of Russia. The results of the research are to be used in regional management.

Keywords: innovation security, border regions, Russia

JEL Code: R12, O30

Introduction

The modern practice of decision-making in regional management faces the need to provide evaluation and monitoring of innovation security, as the innovation development becomes one of the main factors of competitive advantage within global competition. On the one hand, innovation security directly derives from the concept of the general economic security as its structural component and is to inherit the methodology of its indexation that is based on a complex of statistic indexes and a set of their threshold meanings. Such approaches allow to make quick comparison and to indicate the cases of real and potential threats. On the other

hand, the structure and specifics of regional economic reproducing process (and innovation reproduction as its organic and vital part) should be taken into account while evaluating innovation security, as well as the character of current dangers and their particular effect.
Moreover, the existing approaches need the additional instruments in the modern conditions, because the pace of economic, technological and social development increase and system of interdependences between the internal and external environment of a region complicate. The internal innovation security is not to be evaluated separately from the global trends and the productive and technological processes in the neighbor territories. This thesis is especially urgent for border regions as they are located in the frontier zone where different levels of innovation and business activity (as well as different technological orders) face each other, creating the 'potential difference' which causes flows of information, personnel and resources.

The current situation of geo-economic turbulence for the Western regions of Russia gives the example of complication and indeterminacy of their innovation security. As these regions had been the conductive zone of imported technologies' transmission for the European Russia before economic sanctions, at the present time they face unstable and contradictory trends. This situation causes the need for additional instruments and approaches for making diagnostics of their set and forecasting their further abilities to overcome the risks and to maintain innovation development.

1 Innovation security: scientific and policy construct

The dependence of national security in the aspect of innovation development is conceptualized as innovation security. Most Russian scholars consider it to be the element of general economic security (Golova & Sukhovey, 2017; Kormishkin, et al. 2013; Sakovich & Brovka, 2016). It is argued that innovation security implies maintenance of favorable milieu for innovative entrepreneurship that corresponds national interests and withstands the influence of external disturbances. Creating and managing the enabling environment for innovation activity is a complex task implemented at national and regional level (Griffith, et al. 2004; Guellec & van Pottelsberghe de la Potterie, 2004; Smith & Thomas, 2017). Thus, innovation policies are associated with confronting the risks and uncertainty of investment in science and technology, encouragement of research and development expenditure, promotion of deep cooperation between business and academia.

A broad view over innovation security implies innovation to be considered not just as an element in economic, institutional, cultural, organizational, geopolitical and other domains, but as an individual domain. The perspective advocated by Mikhaylova (2018) suggests analyzing territorial innovation systems by their innovation capacity: the integrity and coherence of the regional innovation system (incl. intellectual, knowledge capital) and the ability to use external sources of knowledge. Therefore, innovation security has to be treated in line with regional development trajectory and open innovation frameworks (Fernandes et al., 2018; Hou et al., 2018; Pratama, 2018).

2 Dynamic approach to regional innovation security

2.1 Substantiation of dynamic approach and methodology of study

The need for developing dynamic approach to study and analyze regional innovation security occurs due to a number of factors. The most important of them (especially urgent for border regions) are, firstly, high temps and low predictability of changing market, technological and social trends which cause the two groups of problems. One of them is associated with the fact that most of standard security indicators give the recent static picture, but do not show the dynamic development and forecast of interdependent processes of generation, adsorption and implementation of innovations. Another one is the problem of substantiation of threshold values of the indicators that need the permanent correction because the threshold values of innovation security change, being led by the changes in the proportions of innovation production in the global economy and also in its regional parts. These changes are much faster and bigger in scale then the changes in general economic proportions that indicate the situation of security and stable development.

Secondly, cyclic character of innovation processes (which account some consequent stages from the creation of primary conditions for innovative activity to the final implementation of technologies into production), is combined with the dependence of innovation reproduction cycle on the general economic cycle of regional reproduction. It means that innovation security is characterized not only by the set of indicators, but also by the set of their correlations in dynamics and the length of the lag effect between the significant changes in indicators of the consequent stages of the innovation process.

Thirdly, dependence of the regional innovation production and consumption on the international market and technological conjuncture is combined with the dependence of regional innovation security on the world and meta-regional level of market and technological

competition. Because of this fact the current level of innovation security is only a relative value, dependent not only on the internal proportions, but also on the current world standards and the level of technological competition within the cross-border neighbor space.

Fourthly, there is an occasionally emerging dependence of the regional innovation reproduction cycle or its several stages on the external oscillation waves, including turbulent ones (Gorochnaya, 2018). Maintaining the secure state of innovation reproduction (along with the general economic security) in turbulent circumstances differs from one in situation of relative stability and growth. That is why the diagnostics of innovation security needs the instruments to identify the turbulent oscillations' impact on the regional reproduction.

Summarizing these factors, the innovation security of a region (and especially of a border region dependent on the external environment) is to be defined not as the state of stability and development without high internal and external dangers, but as the ability of a region to struggle with the emerging dangers, to overcome and spread risks. This set of qualities appears with self-organizing mechanisms, when the lag effect of such reaction of 'regional immunity' is not too long for regional innovation reproductive cycle not to be destroyed and regional product to maintain its competitiveness at both global and national markets.

While implementing this thesis into the particular set of methods, it is necessary to analyze the dynamic series of the main statistical indicators of innovative development of a region. When carrying out their statistical analysis, it is necessary to study their growth rates (both of the first and second order; calculated by chain method). This will allow us both to achieve comparability of data and to track the lag effect between the periods of growth and decline of the various stages of the innovative reproduction cycle while comparing the dynamic series. Often the changes in the innovation reproduction (caused both by governmental measures and self-organized processes) do not give the fast impact. Because of this reason the study includes serial comparison between the trends with the lag shift of 1, 2, 3, 4 and 5 years. Also the dynamic approach should include the statistical analysis of dynamic series to identify the trend (that characterizes the general vector of innovation development and the foundation to provide the forecast), cyclic oscillations (it helps to identify the phase characteristics of the self-organizing cycle and the lag effects between the cycles of the stages of innovative process) and cyclic deviations from the average values of the dynamic series (that characterizes the level of stability). Indicators of variance, standard deviation and coefficient of variation are to be used to evaluate the range of dynamic oscillation. The waves

of oscillation (the growth rate takes the indicator cyclically takes values more than or less than 1) after the geo-economic shift of 2013-2014 mean the sensitivity to is, as the turbulent effect manifests (Gorochnaya, 2018). The quantitative analysis should be combined with the qualitative one, that will make it possible to identify the oscillations and deviations to be the reflections of the regional innovation reproduction being impacted by the risk factors and reacted them. Thus, the 2 hypothesis are to be proved. One of them is about the presence of conjugacy between the stages of regional innovative process with the lag shift of 2-3 years; another one is about the geo-economic changes of 2013-2014 cause the turbulent oscillations that reproduce themselves consequently at the stages of innovative process (and some stages can be more sensitive).

2.2 Implementation and empirical evidence

Accordingly to the purpose of research, as well as to the existing system of national and regional statistics, the dynamic series of the main indicators of regional economic security are analyzed, being organized into several groups that suit the stages of regional innovative process. They are:

- the indicators of conditions and facilities of innovative process (the number of scientific organizations, the number of personnel involved into research and development works, the internal expenditures for scientific research);
- the indicators on patenting (the number of patent applications and one of patents registered);
- the generation of technologies by economic organizations (the share of innovative enterprises among all the regional organizations and their expenditures on R&D works, resulted in the number of technologies produced);
- the stage of innovations' implementation in production process (the number of new technologies used, the volumes of goods and services produced with the use of innovations and their share in the regional production).

First of all, the study focuses on the two Russian regions that represent South-West (Rostov region) and the westernmost borders (Kaliningrad region). The study analyzes data during the period 2011-2016, when the negative shift in international economic and technological interaction has influenced the regions of Western Russia.

As the Rostov region demonstrates, the stages of innovative process are not directly interconnected, as the decline in the number of scientific organizations and personnel

involved into research work is not reflected in the production of technologies and innovative goods and services (Tab. 1).

Tab. 1: Growth rates (first order) of innovation indicators in Rostov region during 2011-2016

Indicator	2011	2012	2013	2014	2015	2016
number of scientific organizations	1.09	0.93	0.97	0.89	1.15	0.86
number of personnel involved into research and development works	0.99	0.76	0.99	1.03	0.99	0.96
internal expenditures for scientific research	1.20	1.16	0.99	1.60	0.93	1.00
number of patent applications	0.97	1.15	1.01	0.92	1.04	0.93
number of patents registered	1.01	1.12	0.78	1.12	0.97	0.93
share of innovative enterprises	0.90	1.32	0.89	1.25	1.03	0.85
expenditures on R&D	1.28	3.76	1.11	0.94	1.64	1.09
number of technologies produced	1.44	0.92	1.33	1.19	1.16	1.14
number of new technologies used	1.00	1.06	1.04	1.06	0.98	1.09
volumes of goods and services produced with the use of innovations	1.31	1.61	1.39	1.22	1.58	1.23
share of goods and services produced with the use of innovations in GRP	1.02	1.45	1.25	1.22	1.31	1.01

Source: generated by authors accordingly to: Rosstat

The analysis of the growth rates of the second order and the statistical analysis of trends give the same picture and indicate that the volume of expenditures by both scientific organizations and innovative enterprises is the most changeable parameter (the statistical variance accounts up to 243 254 377,18 in 2016 and the coefficient of variation up to 37% for scientific organizations and 82% for firms). The high variation rate is also typical for the share of innovative production in the GRP, but it develops in the direction of growth.

The comparison of the trends before and after the most active period of geo-economic external shifts (2012-2014) shows that some of the stages of innovative regional reproduction are sensitive to it (mostly associated with scientific activities and patenting) while some are not (mostly associated with the results of innovative enterprises).

The qualitative analysis allows to identify that the relative stability and maintaining growth in the stage of enterprises' R&D work is due to the self-organizing reaction of the region embodied in the attempts to provide the import substitution by using domestic technologies (e. g. via conversion from the military sector to civil production). Also there are trends of intensifying nets between private enterprises and the system of science and education (e. g. via clustering). But despite the positive examples, the organic coordination

between these stages of innovation process is poor; they are still generally disconnected in the region.

The situation of Kaliningrad region shows similar trends: the stages of innovative reproduction cycle are not directly interconnected and develop mostly separately. But the greater extent of external influence (especially after the shift in 2014) makes the difference in comparison with Rostov region. It has caused the oscillation in just all the stages with various length of waves (Tab. 2).

Tab. 2: Growth rates (first order) of innovation indicators in Kaliningrad region during 2011-2016

Indicator	2011	2012	2013	2014	2015	2016
number of scientific organizations	1.0	1.0	1.27	0.86	1.33	0.94
number of personnel involved into research and development works	1.07	0.98	1.03	1.04	1.01	0.97
internal expenditures for scientific research	1.11	0.69	1.19	0.94	1.14	1.13
number of patent applications	0.76	1.2	0.87	0.94	1.11	0.85
number of patents registered	0.79	1.25	0.99	1.01	0.8	0.94
share of innovative enterprises	1.03	1.55	1.0	0.47	1.71	1.17
expenditures on R&D	1.0	2.74	0.92	0.56	4.28	3.62
number of technologies produced	5.0	0.6	4.0	0.08	1.0	2.0
number of new technologies used	1.14	1.01	0.99	0.78	0.98	1.07
volumes of goods and services produced with the use of innovations	2.05	1.86	0.47	0.95	3.38	0.78
share of goods and services produced with the use of innovations in GRP	2.0	1.5	0.33	1.0	4.0	0.5

Source: generated by authors accordingly to: Rosstat

Not only the volume of expenditures (coefficient of variation up to 318.65%) but also the volumes of goods and services (up to 94.81%) and the number of scientific organizations (up to 24%) oscillated in a wide range, while the variance of the number of technologies produced is extremely high as the number itself is very low (about 1-3 just every year and sometimes rises to 10-12). The internal potential of the region does not allow any of the innovation reproduction's stages to overcome the external shifts. As a result, the stages of the innovation process do not have the additional resource for effective interconnection.

Conclusion

As the study has shown, the first hypothesis was not proved, and this fact discovers one of the most urgent problems of the Russian border regions' innovation security, that is disconnection

between the stages of the innovation reproduction process. No any significant interdependence (with the account of lag effects) between them is detected via the statistical analysis of their trends. This problem, typical for the most Russian regions, negatively multiplicands within the space of Western border ones. Such disparity is the main reason of sensitivity of the some links in the innovation production chain to the external shifts.

But the second hypothesis was proved. The analysis of data shows that the initial shift of conditions in the system 'Russia-West' has really caused the turbulent oscillation effect in these sensitive stages of innovations' reproduction (as the most of indicators have been changing in wide range since 2014). Also it is important to notice, that such waves will probably induct the further oscillation (of less scale) in other (more strong and currently less sensitive) stages after the long-term lag effect. That is why applying dynamic approach to indexation of regional economic security is vitally important for the strategic decision-making. Otherwise, the positive situation of the technologies' implementing growth in actively developing regions and relatively stable one in the regions with the less potential does not mark the real threads to the regional innovation security. The instable dynamics in several (or the majority) of the stages can lead to the same trend in the key sectors even in the conditions of their relatively independent status and the direct aid from the government.

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