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Innovation Activity: Localization, New Trends and Assessment Methods

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The purpose of this article is to identify trends and spatial features of the formation of "growth points" in Kazakhstan, based on characteristics of localization and concentration of innovative activity. The main attention in the article is given to the assessment of the various levels of industrial development and innovative activity of Kazakhstan regions, taking into account territorial features and the main directions of industrial development. The article discusses the basic concepts that explain the patterns of regional growth, the localization of high-tech industries and innovative activity, as well as methods for assessing them. Index and coefficient methods, ranking methods, grouping and rating methods were used for the analysis. To assess the innovative activity of regions, a modified rating scale was used, and a modified Krugman concentration index was proposed and used to assess the concentration of innovative activity. We have used relative indicators calculated on the basis of national statistics on science and innovations in Kazakhstan to build the ratings. The assessment of parameters of localization of scientific potential and innovative activity in Kazakhstan regions is carried out. The regions were ranked and the aggregated rating score for the regions was calculated. A typology of the regions of Kazakhstan was developed according to the level of innovation activity, four types of zones of localization of innovation activity were identified: high level (A), medium level (B), low level (C), unsatisfactory level (D). To characterize the local concentration of production of innovative products in Kazakhstan, modified Krugman concentration indices are calculated. The established zones (centers) of localization of innovative activity were identified, and it was concluded that they do not yet have a large impact on industrial development of the country as a whole. In general, positive trends in the growth of indicators of innovative activity and technological progress are observed throughout the country. Nevertheless, the rate of change remains extremely low, which indicates the uneven development of innovations in regions, as well as their territorial and industrial isolation, which has a negative impact on the speed of development of the technological process in the country.

Keywords: *Region; Science-Driven Economy; Innovative Activity; Localization; Growth Points.*

Introduction

Kazakhstan has embarked on a new third stage of modernization transformations - the technological modernization. During the third modernization, Kazakhstan should become one of the 30 developed countries of the world by 2050 on the basis of accelerated technological development (Kohli, 2011; Wilson, 2003). For Kazakhstan, the achievement of the goal to become one of the developed, competitive countries is associated with solving a number of tasks, including overcoming raw materials dependence and increasing the share of non-primary exports to 70 %, creating a diversified industrial sector, increasing R&D costs and creating a knowledge-based economy, and developing human resources.

For Kazakhstan, with its extensive territory, a variety of natural-geographical, social-economic conditions, the trajectory of industrial development is largely determined by features and possibilities of the development of science and innovation in regions. Also, the regional aspect of science and innovation policy is poorly represented.

It is worth noting that the large territorial fragmentation and different levels of industrial and technical development of Kazakhstan regions led to the uneven development of individual branches of science and innovation in regions. For example, in the western regions of Kazakhstan, in which the main emphasis is on the extraction of petroleum products, the main development of innovations and their implementation is associated with oil refining and servicing of drilling stations. In East Kazakhstan, where the main production is associated with the extraction and beneficiation of various ores, metallurgy and material science have a strong influence, while the remaining industries are poorly developed. In Northern and Central Kazakhstan, the main emphasis is on the development of the agro-industrial complex and the coal industry. Livestock breeding is developed in southern Kazakhstan. The vast territory, a wide range of different industries and their development level in the regions leads to an uneven level of development of science and the country's economy. That leads to the migration of human capital from the regions to the more developed centers of

Kazakhstan. Unlike European countries, famous for their high level of development of technology and science, Kazakhstan today is doing everything possible to increase its competitiveness not only in the Asian region, but also among European countries (Keller, 2002; Beaudry, 2009; Zhu, 2018). Today, great attention in the country is paid to the creation of new high-tech technologies, increasing the level of development of science and innovations, as well as the development of industrial centers and reducing raw materials dependence on raw materials export. For this, several state programs on industrialization and digitalization have been launched in the country. Moreover, great attention is paid to the development of the country's regions. In our opinion, the tasks of creating a knowledge-based economy as a whole should be integrated with regional strategies for technological modernization. Regional policy should focus on the formation of centers or “points” of economic growth, take into account the peculiarities of localization, concentration of scientific and innovative potential (Baena, 2017). To justify the priorities of regional policy and the formation of high-tech “points” of growth, to identify the spatial configuration of innovation, it is necessary to develop methods for assessing the possibilities of innovative development of regions (Bahrin, 2016; Slusarczyk, 2018).

Strengthening the "Industry 4.0" and global technological revolution processes put a focus on searching new models of social and economic development, economic growth sources and factors diversification. In this regard, Kazakhstan has taken a course towards a science-driven economy. The goal is to become an industrial state included in a list of 30 most developed countries in the world, owing to diversified and enhanced national economy’s competitiveness and integrated performance growth. Solving these issues required to implement a comprehensive technological modernization of the national economy including regional levels (Dave, 2018; Yemelina, 2018).

For Kazakhstan with its extended territory and significant variety of social and economic, and natural-geographical conditions the industrial development trajectory is determined mainly by the regional level (Jumakulov, 2018). Therefore, a science-driven economy can be built only by regional technology-based modernization strategies, and the country's regional policy has to be focused on setting up the economic growth centers or "points" (Mazhitova, 2018).

Modernization of basic industrial activities, the realization of investment projects aimed at the resource-efficient use of resource potential, setting-up new science-driven industries and activity spheres, and growth of labor performance should become imperative for the regional policy (Bartodziej, 2017; Rydehell, 2018.). Therefore, it is essential to assess the innovative development potentials and scientifically justify the priorities of regional policies aimed at setting the science-driven "points" of growth (Liao, 2017; Rojko, 2017).

Nowadays, taking into account the tendencies of economy globalization, the problem of ensuring the development of a knowledge-based economy, industrialization and computerization is significant for most states (Shaikin, 2018). At present, the scientific literature has sufficiently well studied the issues concerning the research of the influence of innovation activity on the level of country's economic development, and on the state of its economic security. The attention is not given to the mechanism of influence of the level of innovation activity on the state of national security (Konopelko, 2018; Ozer, 2018; Herstad, 2018).

The aim of the article was to conduct a comprehensive study of theoretical and methodological foundations for the formation of knowledge-based "points" of economic growth in a spatial perspective based on characteristics of localization and concentration of innovative activity. Estimation of the level of localization, opportunities and main directions of increasing innovation activity in the economy of Kazakhstan regions will allow us to predict further ways of economic development in the country. Economic-mathematical and economic-statistical methods, methods of comparisons and generalizations, system analysis, index and coefficient methods, ratings and ranking, expert assessments were used as methods of the research.

In the context of globalization and the growth of international competition, the innovative variant of Kazakh economy development throughout its space is virtually uncontested. It justifies the relevance of researching the features of innovative development of the country's regions, assessing the level of its localization and identifying promising areas.

The article assesses the various levels of industrial development and innovative activity of the regions of Kazakhstan, taking into account territorial features and the main directions of industrial development. The applied methods accurately reflect the level of regions and allow isolating problem areas, as well as making a forecast for the near future. It is also worth noting that today, there are not so many works devoted to assessing the economic and industrial level of development in Asian countries, such as Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan. However, the level of sectoral and industrial development in these countries is approximately at the same level, which is due to the territorial and geopolitical position of these countries in the region. In this connection, studies related to the development of innovative activity and the localization of high-tech industries taking into account rapidly developing technologies are of interest not only for representatives of these countries, but can also serve in the future to predict the development of regions taking into account all factors.

Methods

The index and coefficient methods, methods of ranking, grouping, and rating are used. A modified rating scale was used to assess the innovative activity of the regions, and a modified Krugman concentration index was proposed and used to assess the concentration of innovative activity (Ellison, 1997; Guimaraes, 2011).

The rating method was selected in the capacity of a methodological approach to the objective assessment of localization level of innovative activity in country regions. This methodological approach allows through the implementation of quantitative assessments of the analyzed processes in aggregated form, to present their qualitative state and dynamics (Kryukov, V. A. 2018). Despite the

obvious advantages of this methodology, there are some shortcomings associated with a limited set of investigated processes due to the lack of reliable statistical data.

The choice of these methods is based on the territorial and industrial features of Kazakhstan, as well as the level of their development in regions. Assessment of parameters of localization of scientific potential and innovative activity in Kazakhstan regions is carried out, taking into account the main industries of regions and the territorial location, as well as the level of development of large cities in regions.

Theoretical Grounds for Setting-Up the Science-Driven "Points" of Economic Growth

Various theories about regions explaining the patterns and features of regional growth have been established in the world. The theories being a synthesis of neo-Keynesian, institutional and distribution models have received the greatest recognition in context of global industrial revolution: new regional growth theories based on incrementing benefits from scale, industrial and regional clusters, value chains, developed "economic knowledge", national and regional innovation system .

Researchers of the last mid century noted the enthusiasm of economist- theorists for dynamic aspects of the economy to the prejudice of the steric component (Jacques, 2006; Izard 1966). This opinion was supported by other regionalist economists. In particular, H. Boss noted that the most common economic theories do not specify any steric conditions (Boss 1970, 20). A similar point of view was shared by famous modern economists and regionalists such as P. Krugman, M. Porter and A. Marshall.

For example, P. Krugman noted that the economy exists and takes a place on the map (Krugman 2005, 121–126). A. Marshall has focused on territorial aspect of the organizational production factor. He showed that there are two possible ways for industrial growth. The first way is when growth can be achieved through increased number of vertically integrated firms with production scale effect. The second way is related to concentration of a large number of small and medium-sized enterprises in certain regions. They are developing no less effectively than large enterprises due to flexible specialization (Marshall 1995,206, 347–369). A. Marshall was the first who introduced a concept of industrial region as concentration of enterprises on the same territory that used external scale effect. His ideas served as a prototype for modern localization of production and later found reflection in various concepts such as industrial districts and Porter's clusters (Porter 1988, 77–90).

The modern "growth points" setting trends and territorial localization of innovation activity explain the concepts of G. Myrdal (Myrdal 1972, Wojnicka-Sycz, 2013), F. Perru, Zh. Boudeville and P. Porter. Their theories center about emergence and spread of growth centers and channels within the spatial economy, setting up the agglomerations and central places, diffusion of innovations and development of peripheral territories. Based on these theory, provisions the composition of economic growth regional factors includes specialization or territorial distribution of labor, concentration and localization of economic sectors in scope (Tonysheva, 2014).

The "growth poles" theory explaining a modern localization of high-tech industries was justified originally by French Economist, F. Perru. He stated that the growth of the country's economy in all regions does not occur evenly. At first it appears at some points or poles of growth, then it spreads over the economy entirely (Perru, 2007, 17–25; Gunnyak 1955, 60). His attitude centers at the fact that regional growth does not ensure a convergence of different levels of economic development of territories, though some leveling of the "cumulative effect" is possible through the distribution channels.

Under the "pole of growth" F. Perru understands three main components: 1) a leading industry with a strong growth potential and high tendency to innovations; 2) a complex of industries of local importance transferring a leading industry's effect to the entire economy; 3) territorial agglomeration of production capable to provide businesses with "external economy". "Pole of growth" is concentration and innovations occurring center, which under favorable conditions through their diffusion is able to significantly influence on economic growth of all neighboring regions.

Core-periphery model of spatial evolution suggests that a mobile semi-periphery zone exists between the centers, and the periphery, which is more active, and in case of any dramatic changes in evolution conditions is able to intercept the functions of the center. This theory is based on the idea of the key role of sectoral structure of economy and primarily of leading territories, so-called the "growth points" (Perroux 1955, 307–320). However, new investments are concentrated in the "points of growth" to activate economic activity in backward, peripheral and problem areas.

Generally speaking, spatial evolution theories work at all levels: from the world cities and large agglomerations to regional and local centers. However, diffusion of innovations runs evolutionally in two following ways:

1) way one – as per the existing hierarchical system from the city centers (i.e. from largest to smaller cities based on size and status);

2) way two - through the system from adjacent centers to neighboring or adjacent cities (i.e., by "spreading" to neighboring cities which is particularly intense within larger agglomerations).

F. Perru's visions about determining role of the state in establishing the "growth poles" and "channels" for dissemination of innovations are fundamentally important for modern understanding of the need for a balanced regional policy. According to this theory the state should assume the functions ensuring harmonized development and reduced structural and spatial disproportions in the economy of the country and its regions. Inductive planning tool which is designed to ensure integration of different regions' interests should be used to ensure it.

Another regionalist, J. R. Boudeville (Boudeville 1966, 11-112; Treshnikov 1988, 236–237) believes that production growth does not occur evenly in all branches of the economy. It is always possible to identify dynamic so-called propulsive industries. They are stimulating development of entire economy and represent the "growth poles". However, these industries are concentrated in a certain point (area), so-called the "center (pole) of growth". Today, these are

intensively science-driven branches centered the latest scientific and technologic achievements, which are also concentrated in the "growth points" with developed scientific and technical potential and other conditions favorable for economic growth through the innovations.

P. Potier's ideas about axes development refract the "growth poles" theory. It assumes that the territories located between the poles of growth and providing transport communication receive additional impulses for growth due to increased freight traffic, spread of innovations and development of infrastructure. Therefore, they turn into development axes (corridors) defining together with the "poles of growth" a spatial framework for economic growth of a large region or country (Pottier 1963, 12–58; Granberg 2000, 87).

J. Fredmann in his "center-periphery" theory notes that economic growth is concentrated exclusively in the cities (Fredmann 1973). Friedman has advanced an idea of four stage formation of growth centers (cores): 1) formation of local core weakly affecting development of surrounding areas; 2) concentration of small foci of growth in one large center (core) influencing over development of peripheral territories; 3) appearance of some more cores serving as a basis for new polycentric structural growth poles; 4) fusion of all growth centers into an agglomeration structure with a developed peripheral cores network (Kuznetzova, 2002, 25–26).

To describe the influence of growth centers on development of peripheral territories going beyond the development centers and axes J. Fredmann and some other scientists used the "innovations diffusion" model. The essence of this model is that a large agglomeration with its developed industry and scientific base periodically generates impulses for innovation activity. Innovations arising in such a "growth pole" gradually spread over the periphery by gradually improving the backward regions' welfare.

By summarizing analysis of the regional growth theories it should be noted that they differ by regional factors, specifically production location factors; by using the innovations and especially the channels for their distribution as the main factor of the territories growth; by assessed possibilities leveling the interregional levels of economic development through diffusion of innovations and industrialization.

At the same time the theories of regional growth under study do not take into account importance of small enterprises for the regions' economy, and they focus on development of large industrial enterprises not depending on specifics of the region. They do not pay due attention to the internal balance of the production system in the region, do not consider the role of transnational firms in development of the regional economic space and new forms of territory-based production. The main thing is that these theories in many of their initial assumptions and growth objects analyzed are focused on using specific regional policy programs in the course of development mainly in industrially developed countries, where the innovative economy foundations are being established.

This circumstance limits the possibilities of practical application of these theories under Kazakhstan conditions. Nevertheless, individual ideas advanced within these theories can be realized in the regional policy of Kazakhstan. It should be noted that partly some individual approaches of a number of theoretical concepts in particular the polarized development theories have been implemented in practice through the strategic instrument of Kazakhstan. This refers, first of all, to the Forecast Scheme of Territorial and Spatial Evolution of the State until 2020 (Junusbekova, 2013; Veselovsky, 2015). The purpose of developing this forecast was to identify areas and mechanisms to ensure a balanced regional development of the national economy based on the most rational use of social and economic potential of each region of the state. One of the most important tasks assumed territorial concentration of human capital, industrial production and innovation activity in high priority growth points, intensive development of urbanized zones, entrepreneurial activity, ensuring effective employment and favorable environment for the population (Pomfret, 2014, Bouncken, R. B. 2018.).

In general, this document dedicated to forecasting the territorial and spatial evolution of Kazakhstan is aimed at shifting from the regional development leveling policy to polarized development policy. Nowadays, this orientation to some extent contradicts the world tendencies of inclusive development envisaging equal access to social benefits for all categories of the population in all country regions. Nevertheless, the regional policy setting a mission to define the "growth points" is progressive in terms of responding to challenges of the "Industry 4.0" global revolution and building innovative activity clusters at the territory of Kazakhstan. According to the objectives of the existing forecast scheme it is expected to achieve the most rational economic specialization in the regions in the field of nation-wide and regional labor distribution in order to improve competitiveness of the whole national economy. However, it is proposed to carry out innovative modernization in high priority areas of economic specialization as well as to build new digital and high-tech industries. In order to identify opportunities for setting and developing the "growth points" at the territory of Kazakhstan capable of generating innovative activity impulses and spreading innovations to the surrounding periphery. It is required to analyze and assess the possibilities of innovative development of the national economy.

Innovation Activity Localization Assessment Methods

To build the ratings, a method using a set of indicators determining the level of innovation activity in Kazakhstan regions (including regions and cities) tracked by the state statistics has been chosen along with rating estimates tool (Gusev, 2009; Krugman, 1999; Aiginger, 2006). However, in order to obtain a more accurate picture, when comparing the levels of innovation activity in regions the rating used the indicators having not absolute, but relative (specific) measurement units reflecting the innovation activities efficiency. Particularly, given an official statistics available for rating the innovation activity indicators have been selected as follows:

- scientific research and development (R&D) expenses per 1 person involved, in thousand KZT;
- technological innovation expenses per 1 person involved, in thousand KZT;

- level of innovative activity of enterprises, in %;
- share of innovative products (or level of the activities in the field of innovations), in %;
- output of innovative products per 1 person involved, in thousand KZT;
- share of people involved in innovative research and development (R&D) in total number of people involved in the region, in %.

Transition from benchmark indicator values input to aggregated estimates is provided through the following algorithm:

Each of the innovation activity indicators entered the analysis is referred to a leading region with maximum indicator shown as 100 %. Further, in order to determine a rating score for i indicator (Rbi) the parameters of corresponding indicators of investigated regions are recalculated percentagewise to maximum value of the leading region based on the following formula (1):

$$Rb = X_n / X_{max} * 100\% \quad (1)$$

where X_n is a parameter value for N region; X_{max} - maximum value of the parameter; Rb_i - rating score for i indicator. As a result of using the formula (1), we can get series of rating score data for the indicators selected for analysis characterizing degree of each region's parameters proximity to the leading region.

Assessment of the region's final rating based on innovation activity level is provided through calculation of the aggregated rating score (Rb_a) combining individual ratings on all analyzed indicators in one general indicator through the following formula (2):

$$Rb_a = (Rb_1 + Rb_2 + Rb_3 + Rb_4 + Rb_5 + Rb_6) /6 \quad (2)$$

where Rb_a is aggregated rating score; Rb_1 - rating score on R&D expense level per one person involved; Rb_2 - rating score on the level of technological innovation expenses per 1 person involved; Rb_3 - rating score on enterprises' innovative activity level; Rb_4 - rating score on innovative products share (or level of activity in the field of innovation); Rb_5 - rating score on the volume of innovative items produced per 1 person involved; Rb_6 - rating score on the share of people involved in R&D in total number of people involved within the region.

Rating assessment of the innovation activity level in the region will be within the range of 0 – 100 %. Accordingly, the higher value, the higher position has a region in the rating.

If to divide a numerical rating scale assessing the innovation activity in the regions into five equal parts, then each level can be assigned with individual alphanumeric code (for example, by analogy with the Standard&Poor's rating). As a result we get a modified rating scale of the innovation activity in the regions (Table 1).

Table 1

Rating Scale of the Innovating Activity in the Regions

Class	Rating score (Rb), %	Value
Zone A – high level		
A+	80 to 100	Extremely high level of innovative activity
A	60 to 80	High level innovating activity
Zone B – medium level		
B	40 to 60	Medium level innovating activity
Zone C – low level		
C	20 to 40	Low level innovating activity
Zone D – unsatisfactory level		
D	0 to 20	Extremely unsatisfactory level of innovative activity

Note – drafted by authors.

Based on the values obtained from the rating scale of innovative activity in regions one can determine the regions with highest specific indicators taking the highest position in the rating and being the innovative production centers or "growth points".

In addition to the rating-based approach discussed above the Krugman Index was applied to estimate the level of localization or concentration of innovative production within the region. It reflects a territorial distribution of activities, including innovations against the country-based indicators. By modifying the known territory profile assessment approaches (Krugman 1999, 483–499; Aiginger 2006, 255–266; Beloy 2012, 9–28; Vasilyev 2007, 78–84) and using index and coefficient methods one can obtain a modified Krugman concentration index (MIKK) reflecting the innovation activity concentration in the country (MIKK) (formula 3):

$$MIKK = V_{ir}/V_{ic} *100\% \quad (3)$$

Vir - volume of innovative products produced in the region; Vic - total volume of innovative products produced in the country; MIKK is a modified Krugman's concentration index.

Other modifications of this indicator can help to characterize the concentration of local innovative production, for example, share of innovative products in gross regional product (GRP) structure of a region.

Assessment of Innovation Activity in Kazakhstan Regions

Rating characteristics of the innovation activity level and localization were obtained based on a comparative analysis of the regions of Kazakhstan. Calculation of indicators characterizing the innovative activity in the regions of the Republic of Kazakhstan has been fulfilled on grounds of official statistics of 2010, 2015 and 2016. The regions ranking and innovation activity ratings were determined relying on data obtained according to the formula (1). The aggregated rating score (Rb_a) was calculated using the formula (2). Calculations results are based on a sample of 2016 data (Table 2).

Table 2

Rating of Kazakhstan Regions by Innovative Activity Indicators of 2016

	R&D expenses per 1 person involved		**Technological innovation expenses per 1 person involved**		**Level of innovative activity of the enterprises**		**Level of activity in the field of innovations, %**		**Volume of innovative products per 1 person involved**		**Share of people involved in R&D in total quantity of people involved**		**Aggregated rating score (Rb_a)**	
Regions (regions and cities)	000 tenge	Rating score (Rb_1), %	000 tenge	Rating score (Rb_2), %	%	Rating score (Rb_3), %	%	Rating score (Rb_4), %	000 tenge	Rating score (Rb_5), %	%	Rating score (Rb_6), %	Numerical value, %	Alphabetical symbol
Republic of Kazakhstan	10.46	-	162.57	-	9.3	-	5.6	-	52.12	-	0.27			
Akmola	2.44	4.35	22.53	1.38	7.0	46.98	4.8	46.15	50.52	19.53	0.16	14.54	19.9	D
Aktobe	7.30	13.00	54.32	3.34	9.3	62.42	5.9	56.73	40.77	15.76	0.08	7.27	26.42	C
Almaty	1.43	2.55	0.18	0.01	7.8	52.35	5.8	55.77	12.82	4.95	0.10	9.09	20.79	C
Atyrau	10.03	17.87	**1626.82**	100.0	8.5	57.05	5.9	56.73	25.04	9.68	0.13	11.82	42.19	B
Western Kazakhstan	5.60	9.98	73.65	4.53	3.6	24.16	2.3	22.11	10.66	4.12	0.24	21.82	13.77	D
Zhambyl	1.85	3.29	19.39	1.19	10.8	72.48	4.6	44.23	68.06	26.31	0.06	5.45	24.75	C
Karaganda	8.96	15.96	33.75	2.07	10.6	71.14	3.8	36.54	47.72	18.45	0.22	20.0	37.36	C
Kostanay	4.32	7.70	68.23	4.19	11.2	75.17	5.3	50.96	91.38	35.33	0.11	10.0	30.56	C
Kyzylorda	2.87	5.11	94.60	5.81	11.2	75.17	5.7	54.81	19.16	7.41	0.07	6.36	25.78	C
Mangistau	30.11	53.64	2.59	0.16	4.1	27.52	2.4	23.08	1.82	0.70	0.25	22.73	21.35	C
South-Kazakhstan	1.06	1.89	46.40	2.85	6.6	44.29	6.0	57.69	47.43	0.18	0.09	8.18	19.18	D
Pavlodar	1.00	1.78	1296.65	79.70	6.5	43.62	4.8	46.15	23.73	9.17	0.17	15.45	32.65	C
Northern Kazakhstan	0.60	1.07	34.16	2.10	11.3	75.84	**10.4**	100.0	37.32	14.43	0.04	3.63	32.85	C
Eastern Kazakhstan	6.93	12.31	219.79	13.51	**14.9**	100.0	9.6	92.31	79.35	30.68	0.32	29.09	46.32	B
Astana city	**56.13**	100.0	8.85	0.54	13.6	91.27	4.4	42.31	**258.65**	100.0	0.63	57.27	65.23	A
Almaty city	32.71	58.27	14.70	0.90	7.6	51.00	6.1	58.65	19.80	7.65	**1.10**	100.0	32.19	C

Note – calculated based on source data: (Aidakpelova 2017, 261-273).

The assessment showed that the Atyrau region in 2016 was leading in terms of technological innovations expenses per 1 person involved (1.626.82 thousand tenge), while Astana, the capital was a leader in research and development specific expenses (56.13 thousand tenge). The highest level of innovative activity of enterprises was observed in the East Region (14.9 %) and in Astana (3.6 %), innovative products per 1 person were produced mostly in Astana (258.65 thousand tenge). In the context of the share of innovative products made in the regions the North Kazakhstan (10.4 %) and East Region (9.6 %) were ranked as first. An absolute leader in regards to share of people involved in R&D in a total number of people involved is Almaty, the place of the highest concentration of scientific and technical potential.

The assessment of innovative activity in regions in 2010 and 2015 was completed similarly.

From the perspective of regions ranking by the level of innovative activity, the typology of regions was compiled as follows (Table 3).

Table 3

Typology of Regions of the Republic of Kazakhstan by Innovative Activity Level

Class	**Rating score, %**	**Value**	**2010**	**2015**	**2016**
Zone A – high level					
A+	80 to 100	The highest level of innovative activity	-	-	-
A	60 to 80	High level of innovative activity	-	Astana city	Astana city
Zone B – medium level					
B	40 to 60	Medium level of innovative activity	Pavlodar and East Regions, Almaty	Atyrau Region. Almaty city	Atyrau and East Regions.
Zone C – low level					
C	20 to 40	Low level of innovative activity	Aktobe, Zhambyk, Karaganda Regions, Astana city	Akmola, Aktobe, Almaty, Zhambyl, Karagandy, Kostanay, Kyzylorda, Mangistau, North Kazakhstan, South Kazakhstan, East Kazakhstan Regions.	Aktobe, Almaty, Zhambyl, Karagandy, Kostanay, Kyzylorda, Mangistau, Pavlodar, North Kazakhstan Regions, Almaty city

Class	Rating score, %	Value	2010	2015	2016
Zone D – Unsatisfactory level					
D	0 to 20	Extremely low and unsatisfactory level of innovative activity	Akmola, Almaty, Atyrau, West Kazakhstan, Kostanay, Kyzylorda, Mangistau, North Kazakhstan, South Kazakhstan Regions	West Kazakhstan, Pavlodar Regions.	Akmola, West Kazakhstan, South Kazakhstan Regions.

The ratings obtained prove that a high-level innovative activity in 2016 by all indicators analyzed was observed only in Astana. Most of the regions in Kazakhstan had a low-level innovative activity and it also included economically developed regions such as Almaty, industrial Karagandy and Pavlodar Regions as well as mineral production regions such as Aktobe and Mangistau Regions. Three regions in recent years have consistently low-level innovative activity.

At the same time, one can note a positive rating dynamics in the regions of the Republic of Kazakhstan (Table 4).

Table 4

Rating Dynamic in Regions of Kazakhstan by Innovative Activity Level During 2010–-2016

Region	Rating Class		
	2010	2015	2016
Akmola	D	C	D
Aktobe	C	C	C
Almaty	D	C	C
Atyrau	D	B	B
West Kazakhstan	D	D	D
Zhambyl	C	C	C
Karagandy	C	C	C
Kostanay	D	C	C
Kyzylorda	D	C	C
Mangistau	D	C	C
South Kazakhstan	D	C	D
Pavlodar	B	D	C
North Kazakhstan	D	C	C
East Kazakhstan	B	C	B
Astana city	C	A	A
Almaty city	B	B	C

It can be seen from the data presented that the innovation activity in regions of Kazakhstan has significantly increased during the investigated period. Therefore, significant positive shift in ranking (by 2 positions at once) in 2016 compared to 2010 was transition of Astana from the "C" low level innovation activity zone to "A", Atyrau Region from the "D" extremely low and unsatisfactory innovative activity group of regions to the medium "B" group. Most of the regions in Kazakhstan, except Almaty, have also moved to a higher rating zone. If 9 regions of the country were located in an unsatisfactory "D" zone in 2010 their number decreased to 3 in 2016.

Analysis of consolidated rating results allows us to highlight the innovative activity features in the regions of Kazakhstan and make the conclusions as follows.

First, only Astana city belongs to zone "A" with high-level innovative activity. The middle rating scale, zone "B" includes only two regions: Atyrau and East Regions. 10 regions of the country typically are ranked as low and 3 regions (Akmola, West Kazakhstan, South Kazakhstan) have been identified as regions with unsatisfactory levels of innovation activity.

Second, Astana was clearly defined as the main "point of growth" of innovative evolution in Kazakhstan. The highest research and development (R&D) expenses and the largest volume of innovative products per person involved are here. This is mostly due to large-scale works conducted within the International Specialized Exhibition EXPO-2017, as well as opening and operation of new research centers at Nazarbayev University. Particularly, a modern innovative cluster, Astana Business Campus, combining science absorbing small and medium-sized enterprises, institutions, foreign and national innovative companies, venture funds where researchers, businessmen, designers and inventors, students and undergraduates work, is actively developing on the university base. An appropriate innovative infrastructure, scientific laboratories, research centers, schools, scientific achievements commercialization office, business incubator, and a technopark are functioning at the Astana Business Campus.

Third, the former leader in innovation development, Almaty city, currently is ranked first only by share of people engaged in R&D. At the same time, the R&D, technological innovation expenses per person involved are lower than in Astana. As a consequence, the volume of innovations per person involved is also extremely low. As a result, Almaty has moved to a zone of medium and low-level innovative activity. Two reasons explain this fact. The first is that scientific research centers and great intellectual potential are concentrated in Almaty, ideas for all sectors of activities are being generated and qualified personnel for other regions are trained there also. However, practically there is no innovative production in the city. The second reason is the insufficient level of

commercialization of R&Ds, preserving a gap between science and production.

The fourth, in the Atyrau Region, which claims to be a leader and belongs to zone "B" (medium level) at the high share of technological innovation expenses the volume of innovations per one person involved is unjustifiably low. Additionally, the level of innovation products obtained under low-technology production is questionable. This is a partial innovation.

Fifthly, positive trends in the growth of innovation activity and technological advancement indicators have been already outlined in the country. However, the rate of change remains extremely low.

The modified Krugman's concentration indexes (MIKK) were calculated as follows (Table 5), to further characterize a local concentration of innovative products in Kazakhstan according to formula (3).

Table 5

Concentration of Innovative Activity in the Regions of Kazakhstan

Regions (regions and cities)	**Modified Krugman's concentration index MIKK**, %		
	2010	**2015**	**2016**
Republic of Kazakhstan	100.0	100.0	100.0
Akmola	5.02	3.76	4.47
Aktobe	7.06	4.52	3.58
Almaty	0.37	3.84	2.76
Atyrau	0.09	2.25	1.63
West Kazakhstan	-	0.19	0.65
Zhambyl	0.29	8.32	7.53
Karagandy	10.74	5.49	7.18
Kostanay	1.23	10.30	11.66
Kyzylorda	-	2.02	1.40
Mangistau	0.17	0.37	0.10
South Kazakhstan	3.50	16.95	11.91
Pavlodar	**52.34**	1.14	2.07
North Kazakhstan	2.07	3.35	2.64
East Kazakhstan	7.98	3.11	11.11
Astana city	0.01	**30.96**	**27.59**
Almaty city	9.10	7.39	3.68

Note – calculated based on source data: (Aidakpelova 2017, 261-273).

Analysis Outcomes

From the indexes above one can outline the trends and features of innovation activity concentration in the regions of Kazakhstan as follows.

Firstly, the production of innovative products in 2010 was concentrated mainly in Pavlodar, Karaganda and East Kazakhstan Regions (value of the MIKK indexes was 52.34 %, 10.74 %, and 7.98 %, respectively) i.e. in the industrial Kazakhstan regions. In 2016, the situation changed dramatically, the first place in the production of innovative products among the regions of Kazakhstan was taken by Astana (value of Krugman's index, MIKK is 27.59 %). This is understandable due to a fact that a specialized large-scale international exhibition "EXPO-2017" in Astana was one of the primary demo platforms in the world of "Energy of the Future" innovative infrastructure.

Secondly, in 2016, the changed localization of innovative production affected not only the region near the capital but other regions also. Thus, relatively high values of the modified Krugman's innovation product concentration indexes (MIKK) have occurred in Kostanay (11.66), South Kazakhstan (11.91) and East Kazakhstan Regions (11,11).

Thirdly, according to the analysis outcomes, Krugman's concentration indexes (MIKK) on innovative product output volumes in the regions of the country vary significantly. Thus, as of 2016, the resources regions of Kazakhstan (Aktobe, Atyrau, Western Kazakhstan, Kyzylorda, Mangistau Regions) continue to losing ground due to the unfavorable situation on the world market and service-based and industrial regions are oriented towards the production of innovative products.

Fourthly, the fact that the multiplicative effect is caused by the concentration of regional innovation centers close to supply chains as a result of agglomeration comes to attention. The areas, where the agglomeration effect arises start developing rapidly, industrial center grows, intense business activity improves the infrastructure and new connections set to attract more firms to the region. Therefore, the most developed regions today are East Kazakhstan, Karaganda and Pavlodar Regions as well as Almaty and Astana cities can become new "points of growth" for a science-driven economy.

Fifthly, assessment of the level of spatial concentration of innovative products in Kazakhstan regions as a whole corresponds to the tendencies of many countries with developing market economies.

To ensure the resource regions (Atyrau, Aktobe, West Kazakhstan, Mangistau and partially Kyzylorda Regions) can retain their leading positions under the condition of unfavorable changes on the world minerals market the improvement of sectoral structure of the economy and reorientation to the innovative products is critical. In particular, large-scale technology-based modernization of traditional sectors of the economy with the use of modern technologies is recommended; setting new raw material processing facilities on a basis of breakthrough technologies (cogno-, info-, nano-, bio-) and IT-technologies. Supporting the new manufacturing industries by the state-oriented to deep raw materials processing and output of products with high added value through the provision of tax and customs preferences, stimulation of investment, granting governmental subsidies and guarantees, etc. is recommended.

The industrial regions with average and low innovative activity level (East Kazakhstan, Karaganda, Pavlodar, Aktobe, partially North-Kazakhstan, South-Kazakhstan, and Atyrau Regions) require structural reorganization of the economy owing to production chain extension, new technologies borrowing and adaptation; setting up the innovative clusters in the specialization sectors; small- and medium-sized innovative enterprises stimulation; networking based on "quadruple helix model" concept and experience with the "EU 2020 - RIS3" EU Innovation Development Strategy (Ec.europa.eu 2018). Active support from the part of local administration, development of entrepreneurial universities and interaction with research centers, commercialization of scientific research results and supporting the creative industries are also crucial (Nurlanova 2010, 328).

The south and the agro-industrial regions on the north (Kostnay, Akmola, Almaty, North-Kazakhstan and South-Kazakhstan Regions) belong to perspective zones through innovative evolution and competitiveness growth based on natural advantages there is yet slow. They have not only great agrarian potential but also a developed industry (Kostanai, South-Kazakhstan Regions), and the southern regions have a better demographic situation. Problems of these regions are largely due to insufficiently effective spatial development policies poorly stimulating the use of growth resources available and infrastructural development. Additionally, many of them failed to attract significant investments.

It is important to ensure the fullest processing of agricultural raw materials and access to the world markets of high-quality finished products. It is critical to introduce advanced sowing and harvesting technologies, "smart irrigation"; to build intelligent livestock feed systems, mineral fertilization, and pest and weed control; apply "unmanned" agricultural machinery. A great effect will come from establishing and promoting the national brand of natural and ecologically friendly food products ("Made in Kazakhstan") to the world markets.

"Points of growth" of the digital economy are Astana and Almaty cities, where "smart city" projects are being implemented; "smart solutions" are being developed, transferred and implemented in all sectors of the economy and spheres of activity. For example, building a Smart City in Almaty assumes the implementation of digital projects in the field of control of security, mudflow activity, public transport, housing, and communal services, education and healthcare. "Smart" district with digitalized housing and communal services, city and social infrastructure improvement is planned to be built on the right bank of Astana city.

To further develop the *"growth points" of a science-driven economy* its cross-sectoral nature, i.e. outside the industrial sector should be taken into consideration. Special attention is to be paid to the universal informatization and robotization of transport and financial sectors as well as other spheres (building of "smart cities"), high-tech medicine development in Astana and Almaty cities where several well-equipped medical centers are functioning successfully. Innovative activities localization points in these cities: Astana Business Campus and Park of Innovative Technologies in Alatau area near Almaty city gain special support from the state. Also, innovative centers, techno-parks, IT-start-ups, fundamental scientific research, and applied innovations should be prioritized and developed in these cities.

There are prerequisites for the phased setting of high-tech industries based on newly developed technologies with their localization in Stepnogorsk (biotechnology) and Kurchatov (nuclear technologies).

Depressive regions (Zhambyl, North-Kazakhstan Regions, some districts in East Kazakhstan, South Kazakhstan, Almaty, Kyzylorda Regions) need special support. The main direction that can ensure the economic recovery in these regions is developed transport, logistics and communication infrastructure. That would allow to level the remoteness factor of the territories from the centers, Internet coverage; the revival of national art and crafts. Stimulation of social infrastructure and medical services providing inclusive development through the development of special programs and non-standard schemes to attract external financing is crucial along with broad use of public-private partnership mechanisms. Self-government system's extension plays a major role in the development of this type of region.

For wider spatial dispersal of sectors of the science-driven economy in all regions of Kazakhstan to learn digital technologies (3D printing, robotics, additive technologies, etc.) is recommended together with scientific and technical development through venture financing and mixed public and private sectors partnership. Creating design prototypes and production of consumer goods seems to be attractive for the regions of Kazakhstan.

Conclusion

In the course of the study, the established zones (centers) of localization of innovation activity were singled out, and it was concluded that they do not yet exert much influence on the industrial development of the country as a whole. In general, positive trends in the growth of indicators of innovation activity and technological advancement have been observed throughout the country. However, the rate of change remains extremely low. Recommendations are given to ensure the growth of innovative activity in raw, industrial regions, agro-industrial, depressive and perspective "growth points" of a knowledge-based economy.

Also, being manifested themselves in zones of innovative activity, the impulses of industrial growth and innovation can spread to the surrounding territories according to the theory of "diffusion of innovations", using stimulating measures of regional policy.

Therefore, we can outline the gradual restructuring of the old model of the economy into a new model of "growth points" of the science-driven economy in the regions of Kazakhstan.

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