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Scientific and Technological Potential of the Territories of Russia and China: Assessment and Development Prospects*

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Abstract. Russia and China are among the world's leading powers, and they exert significant impact on the world economy and the world's largest markets. In addition, these countries are global scientific centers and occupy leading positions in several branches of science. The intensification of cooperation between Russia and China in recent years is a reason for a growth of interest in studying their scientific and technological potential and finding possible points of interaction in this direction. The problems of socio-economic and scientific and technological development of both countries have much in common, and this fact also increases the interest in its comparative evaluation and the study of the experience of overcoming current problems. In this regard, the goal of the study is to assess the scientific and technological potential and identify areas of its development in Russia and China. Proceeding from the

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goal, the article studies theoretical aspects of scientific and technological development of territories and provides our own interpretation of the concept "scientific and technological potential" based on the combined option that unites the resource-based and effective approaches to this economic category. We develop a technique for comparative assessment of scientific and technological development of territories of two (and more) countries, allowing the regions to be ranked according to the level of scientific and technological potential on the basis of an integral index providing a comprehensive assessment of territories' potential. We also use the technique to assess the drivers of scientific and technological development of territories of the two countries and reveal the problems typical of both Russia and China. We present the results of systematization of the experience of their constituent entities leading in scientific and technological development; this experience proves that the government engages in systematic work to support the development of science and technology. In conclusion we emphasize once again the presence of a significant differentiation of scientific and technological development of regions in the countries under consideration. At the next stages of the research, we plan to develop a system of measures for all their subjects grouped according to the level of scientific and technological development.

Key words: scientific and technological potential, assessment technique, problems, differentiation, territories, development directions.

Introduction

Ensuring economic growth and improving the competitiveness of the country's economy on a global scale is impossible without developing scientific and technological potential. Only states stimulating and actively implementing scientific and technical activities become leaders in hi-tech branches of the national economy: it is reflected in the growing social and economic well-being of their population [1; 2; 3]. It should be noted that the increase in the main performance indicators of economic activity can be achieved through the existing scientific and technological reserves and spare resources of accumulated potential. Russia and China is not an exception in this case. Being in the list of actively developing countries, they set scientific and technological development as strategic priorities. This issue is particularly relevant amid the need to achieve rapid socio-economic development.

The relations between Russia and China are of vital importance in the foreign policy of both countries. In modern conditions, they are becoming key partners both economically and geopolitically. In recent years, they have concluded numerous cooperation agreements in various fields including science, education and technology. At the same time, the steps taken in this direction are still fragmented and not systematic. One of the reasons for this is that there are differences in approaches to the management and promotion of scientific and technological activities, in public policies, as well as in the level of technological development and their resource base.

To determine possible growth zones and arrange interaction between the two countries in science and technology it is necessary to assess the existing conditions and their current scientific and technological potential. In this regard, the purpose for the study is to assess the scientific and technological potential and identify areas in its development in Russia and China. To achieve the goal it is necessary to address the following objectives: study the theoretical aspects of scientific and technological development of territories;

identify factors affecting scientific and technological development (STD); develop a methodology for comparative assessment of the scientific and technological potential of the territories of two (or more) countries, test it based on data from Russia and China; study the experience of the leading Russia's and China's subjects in the field of scientific and technological development; develop a list of tools and measures to activate it in the lagging territories of both countries.

The research novelty of the work is grounded in compelling comparative evaluation of scientific and technological potential of Russia's and China's territories based on the developed author's method, as well as in the development of science-based system of tools and measures for enhancing the processes of scientific and technological development of lagging areas in these countries.

Research relevance

Modern economic theories are divided into three groups: theories of exogenous and endogenous growth, a mixed approach.

Exogenous development of territories is carried out with strong external interference of public authorities including through state (federal) funding. This type of regional development is based on attracting capital (investment, subsidies, etc.), business from other regions and countries and on opening new businesses.

The endogenous approach to economic development of territories focused on research, formation and realization of regional strategic potential, to a greater extent corresponds to the conditions of new global risks and opportunities.

The mixed approach has features of both first and second theory. With this approach the state creates conditions for intensive development of leading territories, which ensures additional economic effect and provides the state with economic, scientific and technological resources, including for their re-distribution to their lagging territories. At the same time, based on main concepts of the endogenous theories of economic growth, federal and regional authorities and management create conditions for the development of territories using internal potential and growth reserves in order to equalize the level of socio-economic development, which remains a priority goal. As can be noted, this applies not only to the economic, but also to the scientific and technological potential (STP). From our point of view, such an approach is more acceptable since by maintaining the growth poles and the territories serving as the driving forces of economic growth, the state ensures the alignment of interregional imbalances due to internal potential of lagging territories.

Our research [4; 5] helps determine that in modern literature, the scientific and technological potential is considered from the standpoint of two approaches: resource-based and result-based. However, both options are secondary and clarifying in the context of studying the measurement of STP. Therefore it is preferable, in our opinion, to focus on a combined option which combines resource-based and result-based approaches, which makes it possible to reflect both the state of STP and the effectiveness of its implementation. Based on this, the scientific and technological potential should be understood as a set of resources and results of activities in the field of science and technology interconnected and interacting with each other and the external environment in certain organizational and managerial conditions to solve the problems of current and future development of the territory, increase its competitiveness and ensure sustainable economic development.

The development of scientific and technological potential is widely discussed at the highest state level. Thus, the Russian Federation has adopted and in implementing the "Strategy for scientific and technological development of the Russian Federation"; "Development of science and technology", "Economic development and innovation economy" programs were adopted in 2013. China approved "The national strategic plan for innovative development" in 2016, which defines the main objectives of development of science, technology and innovation in the medium and long term.

From the above, it can be concluded that the issues of development of scientific and technological potential, which is becoming a key component of the territories' reproductive potential, is recognized as a necessary prerequisite for intensive economic growth by both public authorities and the scientific community.

Based on the previously studied aspects of the scientific and technological potential of territories it is possible to conduct a detailed analysis of the state, level and efficiency of the scientific and technological potential of individual territories in comparison with others. As part of this, we assess the resources constituting the potential, the results of their application, as well as the structural relations between the components of potential as a whole [5].

At the same time, despite many conducted studies, methodological issues of evaluating STP and the elaboration of valid directions of its development remain an urgent scientific issue. This issue becomes particularly relevant in the context of the development of international relations between Russia and China. Both countries are in the process of developing a developed economy, possess significant potential for economic, scientific and technological growth, having similar trends in the socio-economic development. In addition, facts indicate that scientific and technical cooperation between Russia and China is being established [6] within the framework of cooperation of large integration associations (Shanghai Cooperation Organization (SCO), BRICS, etc.).

Thus, addressing measurement issues and searching for directions in the development of scientific and technological potential are important theoretical and practical research objectives.

Research methods

Our research [5; 7] has helped develop the methodical scheme for conducting comparative analysis of the level of scientific and technological potential of Russia and China. With this scheme regions can be ranked according to the level of STP based on an integrated index which gives a comprehensive assessment of the territories' potential. Conditionally calculations can be divided into the following main stages.

Stage 1. To build an integrated index of scientific and technological potential as a result of preliminary analysis we selected indicators (*Tab. 1*) conditionally divided into 3 vertical and 2 horizontal blocks (a posteriori set of particular criteria).

The "Research and development" block considers indicators of the extent of research and development and the results of development of new technological equipment in the region. The "Staff" block takes into account the features of the existing level of education for the implementation of scientific and technological activities, as well as attention paid to the development of educational activities in the region. The "Technology and innovation" block reflects, on the one hand, the availability

Table 1. Indicators of scientific and technological potential assessment*

Indicator	R&D	Staff	Technology and innovation
Resource-based	Share of domestic cost of R&D in GRP (%), Russia Share of domestic cost of R&D in GRP (%) – China	Cost of education (per 10.000 people, mln. rubles) in consolidated budgets of Russia's constituent entities – Russia Education costs (10,000yuan per 10,000 people) – China	Internal current research and development costs (per 10,000 people, thousand rubles) – Russia Domestic costs of research and development (10 thousand yuan per 10 thousand people) – China
Result-based	Patent applications and issues of patents in Russia (per 100,000 people, units) – Russia Number of patent applications (units/10,000 people) – China	Personnel engaged in R&D (per 10,000 people, people) – Russia Personnel engaged in R&D (people/10,000 people) – China	Volume of supplied innovative products (per 10,000 people, mln. rubles) – Russia The volume of shipped new products from industrial enterprises above the established amount (10,000 yuan /10,000 people) – China
* The indicators in monetary terms were converted into equivalent prices and currencies.			

of resources for the development of scientific and technological activities, on the other hand, the main indicators of effective development of methods, processes and tools used in production.

Moreover, these indicators within the framework of the described approach can be grouped by three aspects reflecting relatively separate areas of scientific and technological development and types of scientific, technological and innovation activities, such as:

1) resource-based – includes activities related to basic and applied research;

2) result-based – includes activities related to dissemination of innovation, including sale of high-tech products.

The presented set includes main indicators published annually by state statistics services of the Russian Federation and China in open sources, which increases the reliability of the calculation methods.

Such indicator:

– are characterized by a clear link with the overall level of scientific and technological potential of territories;

– help fully consider the resources and results of scientific, technological and innovation activities;

– are evenly distributed among blocks – components of scientific and technological potential which, according to theoretical provisions, includes educational, scientific, technical, and technological components.

Based on these arguments, such a set of indicators seems to be the most universal. Taking into account the considered interpretations of the scientific and technological potential, it is advisable to preserve the approach whose calculation framework lies in the identification of an integrated indicator of the scientific and technological potential of each region. This is the average value of indices reflecting the previously described individual components (blocks) of potential which, in turn, are the average values of indicators included in them.

Stage 2. The information obtained from official statistics databases should be standardized (reduce to a comparable form suitable for evaluation) according to the following rule:

1) The following formula is applied for the studied indicators which monotonically increase in relation to the resulting indicator, i.e. factor increase (x_j) entails the expansion of the phenomenon under consideration:

$$\widehat{x_{ij}} = \frac{x_{maxj} - x_{ij}}{x_{maxj} - x_{minj}} N, \quad (1)$$

where x_{ij} – the i-th value of the j-th factor,

x_{maxj} and x_{minj} – maximum and minimum j-th factor values,

N – scale factor;

2) The following formula is applied for indicators related to the result of uniform decreasing dependence:

$$\widehat{x_{ij}} = \frac{x_{maxj} - x_{ij}}{x_{maxj} - x_{minj}} N, \quad (2)$$

3) Rare in practice yet possible in theory is the situation where xj is linked to the analyzed integrated index of non-uniform dependence, i.e. between maximum and minimum values there is an optimal – x_{optj}, which gives the best quality. In this case, the following formula is applied:

$$\widehat{x_{ij}} = \left(1 - \frac{|x_{ij} - x_{\text{опт}j}|}{max\begin{cases} x_{maxj} - x_{\text{опт}j}, \\ x_{\text{опт}j} - x_{minj} \end{cases}}\right) N, \quad (3)$$

Thus, unification according to the given rules will help proceed to the next stage of the method.

Stage 3. The implementation of the principal component method by values of particular criteria of a posteriori set of indicators. The application of this method is due to the identification of a hypothetical value (scientific and technological potential) corresponding to a much larger number of initial factors. The advantage of the method is that it does not require preliminary grouping of source data, which greatly simplifies the analysis.

Based on the calculated principal components it is possible to build a simpler informative system of scientific and technological potential, estimate the extent of causation between the factors, study the possible changes in the analyzed factors under the influence of the principal components.

The initial set of indicators was divided into 4 groups. Each of them includes indicators with highest absolute values, characterizing the share of the total spread in the category of scientific and technological potential in each separate line. The first group included indicators such as "Internal current research and development costs, thousand rubles/10 thousand people" (50.65%) and "Patent applications and issues of patents in Russia per 100,000 people, units" (49.35%). The second group – "Cost of education in consolidated budgets of Russia's constituent entities, mln. rubles/10,000 people" (42.22%) and "personnel engaged in R&D, people\10,000 people" (57.78%). The third and the fourth group include one indicator: "share of domestic cost of R&D, in % to GRP" and "volume of supplied innovative products, mln. rubles\10,000 people", respectively.

Stage 4. Determination of the weighing factors for criteria from a posteriori set. Weighing factors (w_j) are determined depending on the hyper-parameters selected in factor analysis (using the principal component method) and are calculated based on the covariance matrix of the a posteriori set of unified partial criteria by the formula:

$$w_{el} = \begin{cases} \dfrac{c_{el}}{\sum_{e=1}^{z} c_{el}}, & \text{if all } c_{el} \text{ are of the same sign,} \\ \dfrac{c_{el}^2}{\sum_{e=1}^{z} c_{el}^2} & \text{otherwise;} \end{cases} \quad (4)$$

where c_{el} – value of eigenvector of covariance matrix of e factor in l block;

z – number of criteria in l block.

Thus, the weighing factors of each indicator in the overall integrated assessment are as follows: "internal current research and development costs, thousand rubles per 10,000 people" –

11.2%; "cost of education in consolidated budgets of Russia's constituent entities, mln. rubles/10,000 people" – 4.26%; "share of domestic cost of R&D, in % to GRP" – 33.07%; "patent applications and issues of patents in Russia, per 100,000 people, units" – 10.09%; "personnel engaged in R&D, people per 10,000 people" – 5.83%; "volume of supplied innovative products, mln. rubles per 10,000 people" – 34.73%.

Stage 5. Definition of index values for the selected blocks. This procedure is carried out by summing the product of unified criteria included in the block, and their respective weighting factors:

$$y_{il} = \sum_{e=1}^{z} w_{ie(l)} \widehat{x_{ie(l)}} \, , \quad (5)$$

Stage 6. Construction of a multiplicative integrated indicator of scientific and technological potential of regions based on the assessment of the general variance (average squared deviation of actual values from their arithmetic mean), according to which the final indicator is discovered according to the following formulas:

$$I_i = N + \sum_{l=1}^{k} q_l (y_{il} - N) \, , \quad (6)$$

$$q_l = \frac{S_l^2}{\sum_{l=1}^{k} S_l^2} \, , \quad (7)$$

$$S_l^2 = \frac{1}{n} \sum_{i=1}^{n} (y_{il} - \bar{y_l})^2 \, , \quad (8)$$

$$\bar{y_l} = \frac{1}{n} \sum_{i=1}^{n} y_{il} \, , \quad (9)$$

We note that a sufficient number of samples is required to satisfy the requirement of the "law of large numbers". The number of factor values must be greater than or equal to the number of factors multiplied by 10. With the selected a posteriori set, the number of factor observations must be equal to 60 (6 factors). An observation from the statistics point of view is a single perception of any object or phenomenon recorded by the observer. There are observations recorded by time (time series) and by a time interval (cross-sampling). There also are observations which take into account both these conditions (panel data).

We add that the set of indicators under study is calculated, i.e. they are taken as shares or relative values to a particular base. Such an approach helps compare the studied objects more accurately with each other. In addition, it should be noted that forecasting the missing observations must be based on a primary sample, rather than on calculation criteria. This procedure will help avoid unnecessary averaging of the estimates.

The following scale is proposed for the interpretation of the calculation of a multiplicative integrated index of scientific and technological potential (*Tab. 2*). The threshold values of the calculated index range between 0 and 1. Therefore, it is possible to distinguish five levels of scientific and technological potential development.

Research results

The method testing has helped rank Russian and Chinese regions according to their scientific and technological potential development. According to the ranking, in 2011 and 2014, in both countries there were no areas with a high level of STP development, in 3 entities, the level of STP development was above average (Beijing, Shanghai, Tianjin), in 4 entities – average (Jaan, Jiangsu, the Nizhny Novgorod Oblast, Guangdong). Saint Petersburg and Moscow ranked seventh and eighth, respectively. The top twenty included 13 Chinese provinces and 7 Russian regions (*Tab. 3*).

Table 2. Scale of regions' scientific and technological potential level

Index value	Level of STP development
(8; 10]	High
(6; 8]	Above average
(4; 6]	Average
(2; 4]	Below average
[0; 2]	Low

Table 3. Ranking of Russia's and China's territories in 2011, 2014 by level of STP development (top 20)

Territory	2011		2014		Change, 2014–2011	
	Index value	Rank	Index value	Rank	Deviation, %	Change in rank
Beijing	7.89	1	7.72	1	97.79	0
Shanghai	6.81	2	6.76	2	99.22	0
Tianjin	5.45	3	6.40	3	117.47	0
Zhejiang	4.43	5	5.57	4	125.72	1
Jiangsu	4.80	4	5.46	5	113.69	-1
Nizhny Novgorod Oblast	3.66	8	4.24	6	115.65	2
Guangdong	3.49	9	4.06	7	116.11	2
Saint Petersburg	3.69	7	3.60	8	97.81	-1
Moscow	3.89	6	3.28	9	84.38	-3
Shandong	2.92	12	3.24	10	110.97	2
Moscow Oblast.	3.22	10	3.11	11	96.76	-1
Chongqing	2.33	15	2.47	12	105.98	3
Anhui	1.97	21	2.44	13	124.38	8
Hubei	2.04	20	2.39	14	116.89	6
Ulyanovsk Oblast	2.94	11	2.38	15	80.90	-4
Fujian	2.17	18	2.31	16	106.68	2
Kaluga Oblast	2.92	13	2.29	17	78.63	-4
Tomsk Oblast	2.52	14	2.17	18	86.01	-4
Liaoning	2.30	16	2.15	19	93.31	-3
Jiangxi	1.63	26	2.13	20	130.89	6
Source: compiled by the authors using [8, 9, 10, 11, 12, 13, 14].						

Thus, analysis of the results indicates that the level of STP development of the territories of China is on average higher than in Russia. At the same time, there are significant imbalances in the development of individual territories in both countries. In addition, the territories of China are characterized by a more active increase in indicator values compared to indicators of 2011.

Chinese provinces demonstrate a more uniform distribution by level of STP development than in Russia, yet more than half of the entities have a low level, in Russia – more than 90% (*Tab. 4*). In China, in 2011–2014, the number of regions with a low level of STP decreased by 10 percentage points, which, despite a slight decrease in the index values of the leading regions, indicates its overall increase. In Russia, however, there is an increase ,yet slight, in the number of regions with a low level of STP. In the context of sub-indices, the situation is similar. The majority of entities in Russia and China have low values in three blocks: "Research and development", "Staff", "Technology". However, in China, unlike Russia, there is a more uniform distribution of entities by block values.

Table 4. Distribution of Russian and Chinese entities by index of scientific and technological potential and its block values in 2011, 2014, %

Index	High		Above average		Average		Below average		Low	
	2011	2014	2011	2014	2011	2014	2011	2014	2011	2014
Russia										
STP index	0	0	0	0	0	1.25	10	7.5	90	91.25
Distribution of entities by STP block										
R&D	0	0	1.25	1.25	1.25	1.25	6.25	5	91.25	92.5
Staff	0	0	1.25	0	2.5	1.25	7.5	12.5	88.75	86.25
Technology	0	0	0	0	1.25	1.25	6.25	5	92.5	93.75
China										
STP index	0	0	6.45	9.68	9.68	9.68	22.58	29.03	61.29	51.61
Distribution of entities by STP block										
R&D	3.23	3.23	9.68	3.23	3.23	12.90	22.58	16.13	61.29	64.52
Staff	0	0	3.23	3.23	6.45	3.23	32.26	16.13	58.06	77.42
Technology	0	0	9.68	12.90	6.45	6.45	25.81	25.81	51.61	54.84
Source: compiled by the authors.										

Table 5. Ranking of Russian and Chinese regions in 2011, 2014 by "Research and development" block (top 20)

Region	2011		2014		Change, 2014–2011	
	Index value	Rank	Index value	Rank	Rank	Index value
Beijing	8.62	1	8.63	1	100.13	0
Moscow	6.94	2	6.29	2	90.62	0
Zhejiang	6.04	5	6.18	3	102.34	2
Shanghai	6.41	4	5.16	4	80.51	0
Jiangsu	6.59	3	5.06	5	76.88	-2
Jiangxi	3.03	11	5.02	6	165.95	5
Saint Petersburg	4.91	6	4.83	7	98.26	-1
Tianjin	4.04	7	4.22	8	104.57	-1
Guangdong	3.87	8	3.77	9	97.50	-1
Nizhny Novgorod Oblast	3.03	12	3.74	10	123.66	2
Moscow Oblast	3.52	9	3.40	11	96.64	-2
Tomsk Oblast	3.06	10	2.59	12	84.80	-2
Shandong	2.59	13	2.33	13	89.83	0
Fujian	2.07	19	2.25	14	108.65	5
Anhui	2.10	17	2.21	15	105.44	2
Kaluga Oblast	2.49	14	2.06	16	82.61	-2
Shaanxi	2.11	16	2.06	17	97.25	-1
Chongqing	1.97	20	1.95	18	98.81	2
Novosibirsk Oblast	1.94	21	1.86	19	96.17	2
Ulyanovsk Oblast	2.37	15	1.81	20	76.59	-5
Source: compiled by the authors.						

According to the block "Research and development" a high level was observed only in Beijing (8.63 in 2014; 8.62 in 2011), the level of STP was "above average" in two entities (including Moscow), in five – "average", in nine – "below average" (*Tab. 5*). It should be noted that in this sub-index out of three the most uniform distribution of constituent entities in Russia and China was observed.

Regarding the sub-index "Staff" the situation is similar (*Tab. 6*). However, here the overall level of potential development is much

Table 6. Ranking of Russian and Chinese regions in 2011, 2014 by “Staff” block (top 20)

Region	2011		2014		Change, 2014–2011	
	Index value	Rank	Index value		Index value	Rank
Beijing	7.08	1	6.63	1	93.74	0
Moscow	6.36	2	6.00	2	94.33	0
Tibet	4.29	5	4.31	3	100.41	2
Saint Petersburg	4.01	6	4.00	4	99.70	2
Tianjin	3.97	7	3.64	5	91.73	2
Shanghai	4.53	3	3.58	6	78.91	-3
Tomsk Oblast	3.78	9	3.57	7	94.56	2
Republic of Tatarstan	2.27	19	3.01	8	132.59	11
Kamchatka Krai	1.59	43	2.89	9	181.58	34
Qinghai	3.82	8	2.59	10	67.95	-2
Moscow Oblast	2.11	21	2.42	11	114.46	10
Xinjiang	2.99	10	2.38	12	79.62	-2
Voronezh Oblast	2.42	15	2.37	13	98.09	2
Ivanovo Oblast	4.51	4	2.27	14	50.33	-10
Shaanxi	2.64	12	2.21	15	83.65	-3
Novosibirsk Oblast	1.74	32	2.15	16	123.69	16
Ulyanovsk Oblast	2.41	16	2.13	17	88.07	-1
Kursk Oblast	1.70	36	2.01	18	117.83	18
Jiangsu	2.32	18	1.93	19	83.40	-1
Samara Oblast	2.06	23	1.93	20	93.58	3
Source: compiled by the authors.						

Table 7. Ranking of Russian and Chinese regions in 2011, 2014 by “Technology and innovation” block (top 20)

Region	2011		2014		Change, 2014–2011	
	Index value	Rank	Index value	Rank	Rank	Index value
Shanghai	7.74	1	7.76	1	100.22	0
Beijing	7.54	2	7.58	2	100.54	0
Tianjin	6.58	3	7.52	3	114.31	0
Jiangsu	4.72	4	6.11	4	129.38	0
Zhejiang	4.39	5	5.93	5	135.18	0
Nizhny Novgorod Oblast	4.06	6	4.82	6	118.75	0
Guangdong	3.75	7	4.51	7	120.14	0
Shandong	3.35	8	3.80	8	113.63	0
Saint Petersburg	2.81	12	3.15	9	111.86	3
Moscow Oblast	3.05	10	3.12	10	102.49	0
Chongqing	2.66	13	2.78	11	104.51	2
Hubei	2.21	16	2.74	12	124.36	4
Anhui	1.98	20	2.71	13	136.36	7
Ulyanovsk Oblast	3.01	11	2.60	14	86.43	-3
Kaluga Oblast	3.17	9	2.57	15	81.10	-6
Liaoning	2.41	14	2.47	16	102.54	-2
Fujian	2.34	15	2.44	17	104.56	-2
Hunan	1.86	21	2.36	18	126.80	3
Shaanxi	2.06	18	2.07	19	100.58	-1
Sakhalin Oblast	0.09	102	1.98	20	2317.83	82
Source: compiled by the authors.						

lower than in the previous case: only one entity reached the "above average level of HR development – Beijing (6.63), its index decreased by 0.45 units compared to 2011. Two entities are characterized by an average level of potential development, 15 more entities demonstrate a "below average" level. In addition, in the majority of entities, a decrease in the sub-index values is also observed.

Judging by analysis of the final sub-index of "Technology and innovation", in 2011–2014 there was an increase in its values in most entities (*Tab. 7*). The "above average" level in 2014 was recorded in 4 entities (all provinces of China), the "average" level – in 3 entities. In 12 other entities the level of sub-index was "below average". It is interesting that the top twenty of entities in on the "Technology and innovation" block consists of about 50% of Chinese provinces (14 units). It can be concluded that the level of technological development and innovation activity in China is higher than in Russia.

Thus, analysis of the index values of scientific and technological potential and sub-indices revealed a very significant gap in the level of STP between Russian entities Russia, which continues to increase. In China, the situation is similar, but during 2011–2014 adjustment of imbalances took place, which suggests that the Chinese policy to support its lagging territories has a certain effect.

The calculation results, as well as our earlier studies on this issue [4, 5] suggest the following most important problems in Russia.

1. There is a spatial imbalance of scientific and technological development. Its HR potential due to its historical features is concentrated mainly in Moscow and Saint Petersburg (more than 70%). In the vast majority of regions, the share of personnel employed in R&D in the total employed population is critically small and cannot significantly influence the increase in innovation activity and the formation of appropriate competitive advantages of territories.

2 The gaps between science, business and education, the focus of support mainly on traditional production rather than on dissemination of innovation in all sectors of the economy cause the concentration of most innovation in a limited number of types of economic activity.

3. Despite proactive active policies in scientific and technological development, the issues of funding have not yet been practically addressed, support tools have not been determined, development goals and objectives have not been set specifically, and target indicators are not being achieved.

Although in China, an increase in main indicators of scientific and technological development was recorded, the country still has certain problems:

1. Lack of world-class human resources in S&T. One of the most important problems of China's scientific and technological potential is that, despite high concentration of staff there are very few talented researchers and world-class experts in S&T.

2. A small number of own breakthrough innovative products competitive at the international level. Experience shows that the development of new industries is based on productive forces established through breakthrough technology. Market competition is a competition of technology, patents, and standards. However, China still remains predominantly a "follower"-country in S&T development, which prevents it from proper development of productive forces. This limits both the development of new industries and the modernization of the industrial structure and the implementation of the national goal of expanding domestic demand.

Table 8. Systematization of experience of supporting the development of S&T potential of the territories of Russia and China

No.	Development area	Territories
1.	Stimulation of innovative activities of industrial enterprises, modernization of production companies, optimization of industrial structure	Moscow, Moscow Oblast, Ulyanovsk Oblast, Beijing, Jiangsu
2.	Large and increasing number of higher educational institutions	Moscow, Nizhny Novgorod Oblast, Beijing, Tianjin, Zhejiang, Jiangsu
3.	Development of the innovation infrastructure, creation of special industrial zones, establishment of institutions to support and assist innovative projects	Moscow, Nizhny Novgorod Oblast, Moscow Oblast, Ulyanovsk Oblast, Beijing, Shanghai
4.	Development of production logistics in the regions	Moscow Oblast, Ulyanovsk Oblast
5.	Legislative support in the field of regulation of the legal framework of S&T activities	Moscow, Nizhny Novgorod Oblast, Saint Petersburg, Moscow Oblast, Ulyanovsk Oblast, Beijing
6.	Legislative support in industrial development, defining industrial policy directions	Nizhny Novgorod Oblast, Ulyanovsk Oblast
7.	ICT funding	Moscow
8.	Establishing a favorable investment environment	Saint Petersburg, Jiangsu, Zhejiang
9.	A s system of technology transfer and transfer of research results to the real sector of the economy	Beijing, Shanghai
10.	Assistance in holding exhibitions and fairs	Saint Petersburg
11.	The system of preferential tax treatment for S&T entities	Moscow Oblast
12.	Development of cooperation between all participants of scientific and technological activity	Shanghai, Tianjin, Zhejiang, Beijing
Source: compiled by the authors using [5; 15;16; 17; 18; 19; 20; 21].		

3. Absence of a full-fledged market environment which would effectively support S&T development. Successful world experience indicates that the market serves as an effective mechanism for resource allocation and a “bridge” between S&T and economic activity. S&T development must be based on the improvement of modern services, especially in science and innovation. In this part, China has a large gap which is the main obstacle to the development of S&T potential and knowledge-based economy.

Despite the above-mentioned problems, both Russia and China have successful experience in developing S&T potential at the regional level. Analysis of experience of the leading entities of the two countries (according to the methodological tools developed by the authors) made it possible to identify similar trends and prospects (*Tab. 8*).

Systematization of experience in the development S&T potential in Russia and China helps make the following conclusions.

1. Priority in this area must be the development of HR potential of the economy. The experience of the leading regions clearly indicates the need to improve the system of education and training of R&D personnel. This will help increase the efficiency of university science.

2. Laws of S&T, innovation and industrial activity in the studies leading regions have been well elaborated, the priority areas of S&T potential are clearly stated in strategies, their financing is carried out both from the national and regional budgets, there is no formalism in their implementation. All this helps maintain S&T potential at a high level.

3. The most important aspect of the development of S&T potential is an obligatory presence of a developed diversified industrial complex as the main consumer of the developed technology, and trained personnel. Moreover, a competitive industrial complex can also provide additional funding for R&D, which will contribute to STP development.

4. The development of S&T potential is impossible without the development of logistics and innovation infrastructure, which ensures interaction of all S&T and at the same time the "flow" of knowledge, technology, and experience. In all studies regions, the authorities and management paid much attention to information and analytical support of the development of S&T potential.

Conclusions

The testing of the methodological scheme developed by the authors has helped identify the regions leading in S&T development in Russia and China and the generalized experience in successful implementation of its support measures gave an opportunity to identify its main aspects to be addressed in lagging regions. These are aspects such as:

1. Development of HR potential of the economy through target policy to train S&T personnel starting from primary school.
2. Development of strategic documents to ensure the development of S&T potential at the regional level.
3. Stimulating the growth of industrial production and diversification of high-tech products.
4. Development of the logistics and innovation infrastructure in lagging regions.

To sum up, it should be noted that the present study is of a complex nature. Its results make a contribution to the development of methodological aspects of assessment and comparison of S&T potential of Russia and in foreign countries. In addition, much has been done in the field of applied science: we analyzed the experience of systematic work of federal and regional authorities and management in Russia and China related to the development of S&T potential. We developed and presented a list of tools and measures to activate the processes of S&T development of lagging territories in these countries.

Further stages of the research will include the improvement of the mathematical framework for assessing S&T potential of territories, analysis of trends in the development of cooperation between Russia and China in S&T, as well as the expansion and specification of the developed system of measures to enhance the processes under consideration. The importance of the obtained results lies in the possibility of their application in the development of strategic documents of federal and regional importance, the definition of mechanisms and methods of state regulation of the development of S&T potential, as well as the possibility of using the methodological research aspects in the study of other countries.

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