

Best foreign practices for innovative development in Russia: the case study of China

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Abstract. In the last 15 years China has been showing the dynamic development of its innovation system which has become the basis for high economic growth that continued even during the global financial crisis of 2009. China's current achievements in the development of innovations are directly related to the state policy which demonstrates their exceptional effectiveness. There is a similarity in problems the transitional economies of Russia and China are now facing in the field of innovative development. The key objective of the presented here research is statistical and structural analyses of the processes taking place in China's innovation sphere. The analysis is expected to reveal what measures implemented within Chinese economy have stimulated the dynamic development of the country's innovation sector. The authors also hope to determine how similar measures can be implemented in the context of the Russian Federation.

1 Introduction

The ongoing COVID-19 pandemic has forced the introduction of previously unseen limitations which together have caused massive decrease in economic rates growth and economic recession in the majority of countries worldwide. Against this background of the systemic reduction in financing of investment projects overall, several directions in the innovation field have demonstrated the opposite trend as they received an additional push to their development. As formulated by the experts representing the World Economic Forum, the current pandemic has accelerated innovations and broadened the Fourth Industrial Revolution with the rapid expansion of e-commerce, online education and remote work [1].

Before the COVID-19 pandemic, development of the innovation sector was moving faster than the rate of the world GDP. For example, back in 2018 it was 5.2% [2]. In five years prior to today's pandemic various international corporations have announced the launch of 5300 research & innovations projects in total, all spreading further than the national markets. These 5300 projects were actually representing slightly over 6% of all newly announced investment projects. Noteworthy, in the five years prior to that, the same indicator was 4000 projects [3]. Also, back in 2018 alone the international corporations listed as top-100 largest non-financial companies invested over USD 350 bln in their R&D projects. Then, in 2019, among 2500 worldwide largest R&D investors, the key indicator

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used in the WIPO Global Innovation Index (GII), the USA came first with 775 companies (and € 348 bln), followed by 421 EU-based companies (€ 189 bln) and then by China with its 536 companies (€ 119 bln) [2]. This, inter alia, confirms the growing rate of Chinese companies' activeness in the innovative sector.

One of the key indicators describing the dynamics of the innovative process within a national economy is global patent activity. Considering that the current global patent activities (75% of them) remain to be concentrated in only five countries: Japan (26%), the United States of America (19%), Germany (10%), China (10%) and the Republic of Korea (9%) [4] — it would fair to assume that the mechanisms of innovations financing in these countries demonstrate the best results. Among these five countries, only China and also Russia belong to the group of countries with transition economies which means that they initially had relatively similar macroeconomic preconditions for an innovative system development. This is why Chinese experience in the field of innovative development could be most useful considering the realias of Russian economy [5].

The key proposal of our research is to apply statistical and structural analysis of the innovative development within China's economy in order to determine the measures that could promote the dynamic development of innovations in Russia. To achieve this, the following research tasks have been formulated:

- to carry out the retrospective and comparative analyses of the preconditions for innovative development in Russia and China during the period from 2013 to 2020;
- to outline the measures of state innovative policy that guaranteed the dynamic innovative development of China's economy;
- to determine the key directions of activities carried out within the innovative sector in China and to single out those that could promote the development of innovations within Russia's economy.

2 Literature review

Innovative development of national economies is largely predetermined by the level of country's international competitiveness and its capacity for future sustainable development, in the course of which innovations would become the fundamental factors of success at the world markets.

Global Innovation Index (GII) data for the years 2013 to 2020 has been used here as the statistical basis for the research. This data contains the results of a comparative analysis across the countries' innovative systems and their rankings by the level of innovative development. The reports under the Global Innovation Index are the results of a collaboration between Cornell University (USA), INSEAD (France) and the World Intellectual Property Organization (WIPO) as co-publishers, along with their so-called Knowledge Partners. GII-2020 has been formed on the basis of 80 indicators combined on seven directions for further analysis. The data covers 131 countries in total. The final ranking is calculated as the average value of two subindices — the Innovation Input Sub-Index (covers institutions, human capital and research, infrastructure, market sophistication and business sophistication) and the Innovation Output Sub-Index (covers knowledge, technology outputs, creative outputs). Therefore, the coefficient of innovations' efficiency is measured as the ratio of two subindices, thus revealing the aggregated results of innovative activity, considering the available innovative potential.

GII allows obtaining valuable information about the dynamics of global innovations, thus providing an opportunity to understand which of the contemporary countries are able to get the most outstanding results in their innovative activities, and also which countries are getting the most efficient output from their investments in creation of favorable

preconditions for innovations that are later transformed into the results of innovative processes.

In our research we have used the following statistical data sources and analytical materials: reports of the World Economic Forum “Global Competitiveness Report 2020”; The Global Risks Report 2021; the UNCTAD report “World Investment Report 2019”; the WIPO report “World Intellectual Property Indicators 2020” as well as statistical data from the WIPO database. Besides that, we have also analyzed various publications dedicated to the issues of state innovation policy implementation in PRC.

3 Methodology

According to classifications of various international organizations, both Russian and Chinese economies belong to the group of countries with the so-called transition economy (economy in transit). The currently transformational period in the development of these economies means that these two countries are facing rather similar problems. As to the common problems in the field of innovative development specifically, the World Intellectual Property Organization in its report on GII assigns Russia and PRC to the same group — the “upper middle-income economies”. In this group, however, China takes the first place, and the Russian Federation is ranked the 6th. At the same time, China is the only exception in the top-30 of the GII leaders, as all the other states in this group belong to the group of “high-income economies”.

The retrospective analysis of China’s and Russia’s rankings as per the Global Innovation Index shows that since 2013 and on both these countries have been seriously improving their national innovation systems. For example, during the period of 2013 to 2020, PRC has moved 21 ranks up — from 35th place to the 14th. Russia’s success was much more moderate — it moved 15 ranks up, from being 62nd to becoming 47th (see Table 1 for more details).

During the last eight years China has been demonstrating high growth of the indicators related to innovative development, thus improving its ranking results for both subindices within GII. At the same time, Russia has been demonstrating positive dynamics as per the Innovation Input (but for 2020 though), however, did not have much success in part of the Innovation Output.

As Francis Gurry, the WIPO Director General, formulated it while presenting the GII 2019 report, “economic powerhouses like China and India have transformed the geography of innovation and this reflects deliberate policy action to promote innovation” [6]. Extraordinary success of China in the development of its innovation system allowed this country to take the leading place in the GII among many other countries, thus being “above expectations” in the group of upper middle-income economies. At the same time, Russia failed to join the group of countries united into the categories “in line with level of development” and was attributed to the group “all other economies”.

On the basis of the comparative analysis of the indicators which together form the two GII subindices (presented in Table 2) we can outline similarities and differences in the dynamics of changes in certain parameters of innovative development in Russian Federation and PRC, as of 2013 and then as of 2020.

Table 1. Dynamics of China’s and Russia’s ranks in GII: 2013-2020 (Sources [2,6,7,8,9,10,11,12]).

Rank (change in brackets)	2013	2014	2015	2016	2017	2018	2019	2020
China								
Global Innovation Index	35	29 (+6)	29 (0)	25 (+4)	22 (+3)	17 (+5)	14 (+3)	14 (0)

Innovation Input Sub-Index	46	45 (+1)	41 (+4)	29 (+12)	31 (-2)	27 (+4)	26 (+1)	26 (0)
Innovation Output Sub-Index	25	16 (+9)	21 (-5)	15 (+6)	11 (+4)	10 (+1)	5 (+5)	6 (-1)
Russia								
Global Innovation Index	62	49 (+13)	48 (+1)	43 (+5)	45 (-2)	46 (-1)	46 (0)	47 (-1)
Innovation Input Sub-Index	52	56 (-4)	52 (+4)	44 (+8)	43 (+1)	43 (0)	41 (+2)	42 (-1)
Innovation Output Sub-Index	72	45 (+17)	49 (+4)	47 (+2)	51 (-4)	56 (-4)	59 (-3)	58 (+1)

Number of countries in each year: 2013 – 142 countries; 2014 - 143; 2015 – 141; 2016 – 128; 2017 – 127; 2018 – 126; 2019 – 129; 2020 – 131.

Table 2. Global Innovation Index of China and Russia, 2013 vs 2020 (Source [2,7]).

	Innovation Input Sub-Index – rank (value)					Innovation Output Sub-Index – rank (value)	
	institutions	human capital and research	infrastructure	market sophistication	business sophistication	knowledge and technology outputs	Creative outputs
China							
GII 2013	113 (48.3)	36 (40.6)	44 (39.8)	35 (54.2)	33 (42.9)	2 (56.4)	96 (31.9)
GII 2020	62 (64.6)	21 (49.4)	36 (52.1)	19 (58.5)	15 (52.9)	7 (55.1)	12 (47)
Change in GII. 2013 to 2020	+ 51	+15	+ 8	+ 14	+18	- 5	+ 84
Russia							
GII 2013	87 (56)	33 (44.1)	49 (37.2)	74 (45.4)	52 (36.1)	48 (30.4)	101 (30.8)
GII 2020	71 (61.5)	30 (45.6)	60 (42.4)	55 (49.7)	42 (34)	50 (26.4)	60 (22.8)
Change in GII. 2013 to 2020	+ 16	+ 3	- 11	+ 19	+ 10	-2	+41

The strongest side of Chinese innovation system, in both 2013 and 2020, is “knowledge and technology outputs”. This indicator is ranked the highest. However, this is the only indicator of China’s innovation system to demonstrate the negative dynamics of changes during 2013-2020, in both rank and value. At the same time we need to mention that its value went down insignificantly, by 1.3 units only, while the rank of this indicator went down by 5 units. This indirectly confirms that other countries, also covered by the GII, are paying serious attention to the development of this parameter. Negative dynamics under this indicator during the 2013-2020 period was also observed in the case of Russian innovation system.

The weakest element of China's innovation system, in both 2013 and 2020, is the "institutions" indicator. Despite all the efforts taken at the state level to develop innovative institutions during the period of 2013-2020 (+51 in rank), this side of the innovative development remained to be the least performing one. Noteworthy, in the case of Russia, this indicator also has the lowest numbers.

Both countries in questions were most successful in improving the element known as "creative outputs" — +84 in rank for China and +41 in rank for Russia. Moreover, in the case of Russian innovation system, the measures taken to improve "business sophistication" have been so significant that this indicator is not the least performing one any longer.

The strongest side of Russia's innovation system is (and has been for many years) the indicator of "human capital and research". This became possible due to high ranks in the following parameters: tertiary enrolment (17), number of graduates in Science and Engineering (15), local universities' ranking in QS (21) and also pupil-teacher ratio in secondary education (19).

According to the GII 2020 reports, by its quality of innovations Russia took the 27th place in the overall ranking and also the 3rd one in the group of middle-income countries, straight after China and India. Despite the decreased number of the so-called corresponding patents (when several countries issue patents for one and the same invention), the Russian Federation has managed to achieve prominent results in quality of its research publications. The indicators were especially impressive in the three largest universities of the country.

Taking into account that China's successes in the development of its national innovation system have been much more significant, the experience of this country should be considered for the potential application in Russia.

4 Findings and recommendations

China is very consistent when it comes to implementation of its policy aimed at transforming Chinese economy from being the global producer of commodities into the global center of innovation productions. Initially, within the BRICS group, the major competitive advantage of China was the availability of cheap labor force [13]. Today, however, China is taking serious action aimed at qualitative transformation of its labor force and preparation of national research-oriented human resources which includes overseas education for the Chinese. Since PRC does not currently have a sufficient number of the world-level universities, the state strongly encourages getting education in foreign educational institutions. At the same time, Chinese authorities manage to prevent the complex problem of "brain drain" as the country is creating most favorable conditions for business-oriented young people that would like to start innovative business within the country [14,15].

China is also strongly oriented on establishment and development of scientific & technical clusters which serve as centers of the innovative development concentration. The largest number of clusters, within the top-100 clusters according to the GII data, are currently US-based (25 of them), China takes the second place in the world, with its 17 innovative clusters. Overall, the top-100 of all innovative clusters in the world covers 26 countries only, six of these countries (including China and Russian Federation) belong, at the same time, to the category of middle-income countries. If we range these clusters by the level of their scientific-technical capacity (which is calculated as the quotient from the sum of patents and research publications per population number), then only two clusters would remain on the list — one from China (Beijing-based, 4th place) and one from Russia (Moscow-based, 13th place). This confirms that in comparison with many European and American clusters, Russian and Chinese clusters have relatively low innovative capacity.

However, in this direction too, China has already achieved some positive results, namely, in part of increasing the patents number.

Thus, despite the decreasing number of patent application worldwide back in 2019 (the decline was recorded at 3%, thus becoming the first decline since 2009, the year of financial crisis), the National Intellectual Property Administration of the People’s Republic of China (CNIPA) received 1.4 mln patent applications. This was more than twice the amount received by the United States Patent and Trademark Office (USPTO) in the same year. Among the top-five offices, China’s share of the world total has increased considerably over the past ten years – from 17% back in 2009 to 43,4% in 2019 [16]. Figure 1 below demonstrates visually the dynamics of the patent applications numbers of PRC during 2010-2019.

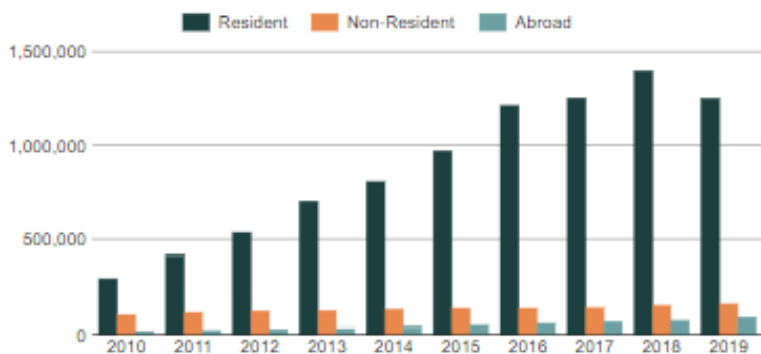


Fig. 1. Patent Applications (Source: WIPO statistics database; last updated 01/2021).

China has also managed to attract private capital to the innovative development of its national economy. As of today, China has over 120 high-tech zones operating in the country, and only 50 of them are state-owned [17]. These high-tech zones promote the commercialization of Chinese scientific and technical achievements, thus boosting the development of the most tech advanced sectors which China treated as the so-called innovation niches — these are IT and biomedical studies. The number of patent applications submitted by Chinese companies operating in the IT and biomedical sectors (see the 2017-2019 data presented in Table 3) confirms that innovative development in this segment is obviously on a high rise.

Table 3. Chinese companies - PCT Top Applicants, as of 2017-2019 (Source: [10,11,12]).

Applicants	2017	2018	2019
HUAWEI TECHNOLOGIES CO.. LTD.	4.024	5.405	4.411
GUANG DONG OPPO MOBILE TELECOMMUNICATIONS CORP.. LTD	474	1.042	1.927
PING AN TECHNOLOGY (SHENZHEN) CO.. LTD.	23	336	1.691
ZTE CORPORATION	2.965	2.080	1.085
SZ DJI TECHNOLOGY CO.. LTD	270	722	874
ALIBABA GROUP HOLDING LIMITED	707	335	846
SHENZHEN CHINA STAR OPTOELECTRONICS SEMICONDUCTOR DISPLAY TECHNOLOGY CO.. LTD.	972	567	654
VIVO MOBILE COMMUNICATION CO.. LTD.	1	179	603
WUHAN CHINA STAR OPTOELECTRONICS SEMICONDUCTOR DISPLAY TECHNOLOGY CO.. LTD.		10	506

An additional motivation for private companies to invest in innovations is the fact that China has made it mandatory to use part of private income for innovation-oriented purposes. This has significantly increased the demand for innovations within Chinese economy.

Within the frameworks of its state innovative policy Chinese government has managed to achieve its key goal: to promote innovations within the private sector, keeping the largest tech companies as state-owned at the same time. In such a way, Chinese authorities are able to influence, directly and timely, on the very hotbeds of innovative development in the country. At the same time, small and mid-sized innovative enterprises are kept under market self-financing, however, with some active state support. Simultaneously, a range of large foreign corporations, such as General Motors and Volkswagen, have launched their research projects on China's territories. This is a relative new trend in innovative activities of transnational corporations since previously they used to keep their R&D activity in the countries of their headquarters primarily [3].

Thus, China stands to gain quite a lot from its integration into the global chains of value creation and its participation in the international innovation systems.

5 Key results

After analyzing the outstanding experience of PRC in the field of innovative development, we can outline the measures that, in our opinion, should be urgently taken by Russia in order to maintain its national innovation potential and also to develop further its state innovative system.

First and foremost, Russia needs to solve the problem of “brain drain” through establishment of innovation centers and scientific-technical clusters in which most qualified professionals would be able to apply their research potential. This problem is extremely acute for Russia today. According to the data of the Boston Consulting Group survey, the desire to leave the country is the highest in the group of most qualified human resources. Among 24 ths respondents, the desire to work abroad has been confirmed by nearly half of Russian scientists, 54% of top managers, 54% of the IT professionals, 49% of engineers and 46% of doctors. Almost two thirds of all potential emigrants (65%) are the so-called “digital talents” — AI experts, UI designers, etc. [18]

Secondly, Russia needs to determine the strategically most important directions for further innovative development, defining, *inter alia*, the innovative niches as China did. Russia has implemented the Strategy for Innovative Development of the Russian Federation for the period until 2020. However, further strategic-level documents, in particular, a strategy for further development, until 2030 have not been approved on the state level. Thus, Russia does not have now state-approved directions for innovative development, but only separate, sectoral elements of a potential strategy. Without a systemic vision on future directions in innovative development achieving success in this field does not seem to be realistic.

Thirdly, it seems to be necessary to promote private support for innovative productions, similar to China's experience with scientific and technical agencies. In China, these agencies serve as private intermediary organizations, the activity of which is aimed primarily at reducing barriers in the course of innovative solutions implementation. In Russia such institutions as Russian Venture Company, venture funds of the Public Joint Stock Financial Corporation “Sistema”, Skolkovo Fund, etc. are working mostly with already mature startups and very seldom engage in financing the initial stages of startups' development (namely, the stage “from idea to MVP”).

Fourthly, the country needs normative regulation over the mandatory use of partial income for innovative purposes, as opposed to mere provision of tax preferences for

innovation financing as it is currently implemented in Russia. This would require redefining of innovative development priorities by economic sectors from the standpoint of their competitiveness improvement and national export potential boost.

Fifthly, transnational corporations should be better attracted to financing and organization of various research projects on Russia's territories. The country has sufficient intellectual resources for that. The most recent and relevant example in this regard is the COVID-19 vaccine development, in which Russia turned out to be one of the leaders. Other promising directions include such strongly innovation-oriented sectors as defense industry, space, pharmaceuticals, artificial intelligence.

To sum up, the current innovation policy of the Russian Federation needs specific adjustments, namely, its strategic priorities need to be re-determined. This would create much better preconditions for long-term planning and cooperation with potential innovation investors. The PRC experience in this field can indeed serve as the basis for maintenance of dynamic innovative development in Russia.

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