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POSITIONS OF THE BRICS COUNTRIES IN WORLD ECONOMICS INNOVATION

Summary: There are many new leaders – not only regional but also global, and this is the indicator of emerging multipolar world. Issues of the development of BRICS and the position of these countries in the world economy was considered in this context. Aim of the paper is to show role of China in BRICS group, which does not establish a *sensu stricto* system Paper is focusing on CGI index. The comparison of the positions of the leading countries of the world economy and the BRICS countries in international rankings of the innovation development was held in this article.

Keywords: BRICS, R&D, information and communication technology (ICT), innovation economy, emerging markets, international rankings.

JEL Classification: O10, O31.

1. Formulation of the problem

The BRICS are very different countries. Political structures of BRICS are markedly different. The cultures of multiethnic population, living in each of them, are diverse. In demographic terms, they are also very different countries. There are two countries with more than a billion people in BRICS group – China and India. They are hardly comparable by territory size and existing natural resources potential, although the resource potential of each country is very considerable for the world economy. But yet, among the key features, which unite BRICS countries, the following should be noted: significant economic growth rates, huge human capital (population and intellectual resources), absolute lead-

ership in each of their geographic region, and, the most important, the ability to make a profound impact on the world economy in the next 20-30 years. All BRICS countries are actively transforming, modernizing and rebuilding, becoming from the regional leaders into the largest players in the global arena. The complex of basic parameters of economic development of the BRICS countries confirms the importance of this association, which is open for accession of other countries.

This article is a part of a series of scientific publications. Earlier, Russia's position in the international rankings was characterized and the analysis of the country's place in comparison with the CIS, where Russia is still the undisputed leader, was done [Rodionova, Gordeeva, 2010]. Besides, the issues of regional development of Russia were considered as a problem on the way to new horizons and the higher position in the world economy [Rodionova, Kokuytseva, 2011]. Also, Russia's position was compared with the countries of Central and Eastern Europe [Galkin, Rodionova, 2013; Rodionova, 2013]. Four of the BRICS countries (China, Russia, Brazil and India) are the largest emerging economies in the world. In this article, the places of the BRICS countries in the international rankings of innovation capabilities will be characterized in comparison with the positions of the leaders of the global economy.

The aim of our research (in contrast to previous studies) is to evaluate the position of BRICS countries in international rankings of the innovation development. We wanted to show, in this context, that technological development and introduction of ICT are the long-term driving forces for the countries' economic growth in the context of globalization; to identify the problem points in modernization process of the BRICS countries during the transition to innovative development.

While analyzing of the positions of the BRICS countries in international rankings, it is important to understand what should be done to ensure, that these states will stay among the leaders of the world economy. First of all, it can be done through the development of their own innovative paradigm of national development. This article also offers an analysis of the BRICS countries positions in the global industry and in the production of high-tech products.

Finally, the position of the BRICS countries in the ranking of The Global Competitiveness Index (GCI), calculated for 139 countries, in which indicators of the index ranges from 1 to 7, is characterized [World Economic Forum, 2015a]. Integral index determines three main positions: basic conditions, factors of efficiency and factors of innovation.

The World Economic Forum which has been measuring competitiveness among countries since 1979, defines competitiveness as “[...] the set of institutions, policies and factors that determine the level of productivity of a country” [World Economic Forum, 2017], which in turn determines the level of prosperity an economy can reach. And it is pointed out that the more competitive countries are able to provide a higher level of income for their citizens. To compile its GCI, the World Economic Forum looks at many components, grouped into 12 ‘pillars of competitiveness’, of which higher education and training is the fifth.

Information about all the components of the Index is very important for the comparison. Competitiveness Index includes 113 variables that describe in detail the competitiveness of countries in the global economy. It is important to note that one factor (a variable) alone is not able to improve or provide a high level of competitiveness of a national economy. Thus, the effect of increasing cost of education can be reduced, for example, because of the labor market inefficiency and etc.; or there will not be any high results if the graduates do not have any opportunities to be appropriately employed. Attempts to optimize the control of the public finances will be successful only in the absence of corruption, transparency, financial management, etc. It is important to take into account the fact that employers will invest in R&D and implement new technologies into production, only if the potential profits exceed the necessary investments.

China has the best position, among the BRICS countries, in this ranking – 29th position in 2015-2016. In the ranking of 2010-2011, Russia ranked 63rd place (in the ranking of 2011-2012 – 67th), and in 2015 – 64th. It should be pointed out that our country lags behind OECD countries on the average value of the Global Competitiveness Index (the average rate of the index of OECD countries is 4.9 on a 7-point scale, while Russia’s – 4.25).

At the beginning of the rating table, i.e. in the group leaders, are: Switzerland, Singapore, Finland, Germany, the USA, Sweden, Hong Kong, Japan, Netherlands, United Kingdom and other developed countries. It is important to notice that China has moved already to 29th place, up close to the Republic of Korea, and both states are far ahead of Russia in many respects.

And the more detailed analysis of countries’ positions on every component of the Index shows what factors have the most significant impact on the development of BRICS countries in recent years, and what reasons lie behind the great difference of countries’ positions in the international ranking.

The factors include: 1) basic conditions (27%): institutions, infrastructure, macroeconomic environment, healthcare and primary education; 2) factors increasing efficiency (50%): higher education and professional training, goods and

services market efficiency, labor market efficiency, level of financial market development, technological level, size of the market; 3) factors of innovation: ‘advancement’ of business, companies’ competitiveness, innovation potential.

Thus, it should be emphasized again that ICTs play a major role in creation and implementation of innovation, increasing of productivity and competitiveness, contribute the diversification of economy and stimulate business activity.

1.1. Research methods

The main characteristics of the forming knowledge society are: uneven development of countries and their regions, including in the usage of ICT (‘digital divide’); advances in knowledge, which determine the progress of modern society; innovative nature and rapid technological progress; dynamism of phenomena; convergence; synergy effect; network structure; integration and interworking; global scale [Galkin, Rodionova, 2013; Antipova, Rodionova, 2014].

Nowadays, the level of scientific development, global technology market and knowledge-based industries provide the basis of dynamic economic development and this a factor of the formation of power centers of global economy. The importance of high-tech industries and high technology for economic growth is diverse. They are materialized in the results of research and development (R&D), they also determine the demand for scientific research and, thus, they contribute to the development of fundamental science. The high-tech industries and high technology constitute the basis of the proposals of logistical and information innovations for all sectors of the economy without exception.

At the beginning of this article, we present a picture of the modern ‘scientific landscape’ of the world, identify the positions of BRICS countries in R&D expenditures and other characteristics of the emerging innovative society.

At the next stage of the research of the BRICS position in the world economy, several international rankings, which reflect the willingness of the countries of the world to economy based on knowledge and characterize features and implementation level of ICT, were selected. They are: Knowledge Economy Index (KEI), Networked Readiness Index (NRI), Informational Society Index (ISI), Global Innovation Index (GII). Initially, representativeness of selected international ratings was assessed and calculations of correlation between indices of the countries of the world in these rankings and individual indicators of economic development (based on 4 indicators: GDP per capita, R&D expenditures per capita, gross value added of high-tech products per capita, production

of ICT goods and services per capita) were performed. Then, the positions of the leaders of the world economy and the BRICS countries in international innovation rankings were compared.

The statistical base of our research is presented by the materials of authoritative international publications and analytical reports of the World Bank, the World Economic Forum, etc. Statistics on the volume of production in the high-tech industries and knowledge-intensive services in the dynamics in 1997-2012 were taken from the database of the National Science Foundation of the USA [National Science Foundation, 2016]. Theoretical basis consists of the numerous research papers on the analysis of R&D and the BRICS problems and development trends of domestic and foreign authors, including the author's own results of the research.

2. BRICS positions in the international rankings

At present, there are several complex indicators (integral indices) characterizing the level of the development of knowledge-based economy. They show the differences between countries in the degree of the usage of innovation and information technologies.

Only the states with the highest socio-economic development are ready to the development of network economy (knowledge-based economy and wide implementation of ICT). Those countries that have put the knowledge and ICTs at the service of the economy are the leaders in the manufacturing of high-tech products and, due to this, occupy the top positions in the world economy [Galkin, Rodionova, 2013; Rodionova, 2013].

Countries with high prevalence of ICT also achieve significant results in the prosperity of the population (GDP per capita growth). However, this effect works only when a country reaches a certain threshold of ICT usage through the governance of socio-economic development. The countries with the high share of illiterate population are not able to attain this effect (India with its 109th position in Knowledge Economy Index is an example).

Knowledge Economy Index (KEI). "The Knowledge Assessment Methodology" proposed by the World Bank for characterizing the countries' capacity to create, receive and spread knowledge, is the basis of the calculation of Knowledge Economy Index [World Bank, 2012].

Analysis of the data, presented in this table, allows to estimate the positions of the BRICS in the world ranking and to identify their positions in comparison

with other countries by the components of integral indices (including institutional regime, innovation, education, ICT usage).

Leading positions in the ranking are occupied by Western European countries (Sweden, Finland, Denmark, the Netherlands, Norway) with high rates of innovative economic development. Russia's position in this ranking is not high: 55th place out of 145 by Knowledge Economy Index. But positions of other BRICS countries are even lower: Brazil has the 60th position, South Africa – the 67th, China – the 84th position and India – the 109th.

Many countries of Central and Eastern Europe – Czech Republic, Poland, Slovakia, Croatia, Romania, Bulgaria and Serbia are ahead of Russia. At the same time, many CIS countries are on even lower positions than Russia in this table (from 56th of Ukraine to 106th of Tajikistan) [Rodionova, 2013].

Russia has particularly low figures on one of the Index components – the institutional regime. China and India also have significantly low index values on the following Index elements: institutional regime, education, informational technologies usage; South Africa – on ICT usage.

Global Innovation Index (GII). As in previous years, the GII relies on two sub-indices – the Innovation Input Sub-Index and the Innovation Output Sub-Index. As a result, four overall measures are calculated: the overall GII, the Input and Output Sub-Indices, and the Innovation Efficiency Ratio. The 143 economies and 81 indicators, presented in the GII 2014, cover a range of themes, providing us with a rich dataset to analyse global innovation trends. However, it is important to note that the GII model has changed over the last editions. So, in ranking table of GII in 2014, the following can be marked: China has the 29th (35th – in 2013) place, Russia – 49th (62nd – in 2013), South Africa – 53th (58th – in 2013), Brazil – 61st (64th – in 2013), India – 76th [INSEAD AND WIPO, 2015]. The leading countries in the ranking are Switzerland, UK, Sweden, Netherlands, Finland, the USA, Singapore, Denmark, Luxembourg, Hong Kong, Ireland. Japan is on the 19th line among 143 countries in the rating.

Networked Readiness Index (NRI). The Networked Readiness Index (NRI), part of the 2014 Global Information Technology Report: The Risks and Rewards of Big Data, published today, ranks 148 countries for the quality of their digital infrastructure and ability to use ICTs to generate economic growth, foster innovation and improve the well-being of their citizens [World Economic Forum, 2015b]. The Networked Readiness Index measures, on a scale from 1 (worst) to 7 (best). NRI is calculated on the base of three data sets: 1) availability of network infrastructure; 2) readiness to usage it in the civil society, business sphere and government structures; 3) the real level of ICT usage. Environ-

ment Component = $\frac{1}{3}$ Market Environment Subindex + $\frac{1}{3}$ Political and Regulatory Subindex Environment + $\frac{1}{3}$ Infrastructure Environment Subindex.

Index components reflect the key factors that influence the information technology development. So, characterizing the positions taken by the leading countries and rapidly emerging BRICS countries is the important stage.

It should be noted that there have been some changes in the ranking on Networked Readiness Index – compared with the rating in 2009. The number of analyzed countries increased from 134 to 148. Though there were insignificant rearrangements in the group of leaders, the first places in 2014 were taken by: Singapore, Finland, Sweden, Netherlands, Norway. It is important to notice that Russia is just on 41st place in the rating table in 2014, and is followed by China (62nd), Brazil (84th), South Africa (75th) and India (89th).

But the most important item is a detailed analysis of countries' positions on the individual components of the Index, which characterize not only the level of usage of network structures (number of Internet users, mobile phones, personal computers, access to the Internet, etc.), and also factors that contribute to this process. They are: a) level of access to network technologies from the position of infrastructure development, equipment availability, etc.; b) policy in the field of network technologies: ICT policy, business and economic environment); c) level of the development of network society: education process supported by network technologies, ICT possibilities, social capital); d) level of the development of network economy: e-commerce, e-government, general infrastructure). Exactly by these positions there are differences between the leaders and BRICS countries, so, it illustrates their low positions in the ranking.

3. Promotion of high-tech products to the world market

Issues about the development of new and modernization of existing instruments and mechanisms for the introduction of innovative technologies in industrial production; the increase of innovation activity of organizations; the government support of high-tech sectors of the economy, attracting financial resources, as well as promotion of high-tech products to the world market are relevant to all of the BRICS countries [Rodionova, 2014].

Countries drastically differ in terms of such indicators as value added of all manufacturing industries (MVA) and per-capita MVA, the proportion in the global industrial production export and others. Per capita MVA is a widely accepted measure of level of industrialization. The data in the table provided allow to analyze this indicator change in countries of different types and at different levels of development (Table 1).

Table 1. MVA per capita at constant 2005 prices in US\$, 1995-2014

Country group	1995	2000	2005	2010	2013*
World	911	1028	1131	1201	1262
Industrialized Economies	3733	4291	4646	4610	4750
Developing & Emerging Industrial Economies (EIE)	233	279	356	472	533
Emerging Industrial Economies (EIE)	347	381	435	506	532
China	227	349	556	914	1142
Other Developing Economies	133	145	169	196	199
Least Developed Countries	30	34	40	50	57

* UNIDO Estimate.

Source: Based on: UNIDO and INDSTAT4 [2015].

Now China has moved to the world leading positions regarding the manufacturing of the majority types of industrial products [Rodionova, 2014]. This thesis has been formulated on the base of analysis of the UNIDO statistical database [UNIDO and INDSTAT4, 2015] and database of the Science and Engineering Indicators [National Science Foundation, 2016]. The manufacturing sector indicators in the countries – the leaders of the world economy and BRICS countries are presented in Table 2.

Table 2. Value added manufacturing industries (MVA): leading countries of the world industry and BRICS, 2005-2013, at constant 2005 prices in US\$

Country	Share of the world MVA, %		MVA per capita, \$	
	2005	2013*	2005	2013*
USA	22.38	19.14	5195.8	5397.6
China	9.88	17.62	926.9	1163.8
Japan	12.18	11.63	7872.4	8263.8
Germany	7.68	6.55	6760.3	7195.1
Republic of Korea	2.81	3.59	5823.7	6602.7
	...			
Brazil	1.84	1.66	775.1	745.7
Russia	1.61	1.55	871.6	974.8
India	1.59	2.29	154.5	161.6
South Africa	0.55	0.53	886.1	933.1

* UNIDO Estimate.

Source: Based on: UNIDO and INDSTAT4 [2015].

The features of the dynamics of production and exports (imports) of high-tech products and production of KTI industries (include knowledge intensive (KI) services and high technology (HT) manufacturing industries classified by Organization for Economic Co-operation and Development), ICT sector and KTI services (include education, health, and business, financial, and communications services) in the BRICS countries were identified. A comparison of the

positions in the value added of high-technology manufacturing industries of the leading countries of the world economy and BRICS was done (Table 3). It is noted that in the period 1999-2014 share of the BRICS countries has increased from 6 to 31% in the world value added of high-technology manufacturing industries. Thus, the share of U.S., Japan and the EU declined.

Table 3. Value added of high-technology manufacturing industries, by region/country, % (1999-2014)

Region/Country	1999	2000	2004	2008	2012	2014
World	100	100	100	100	100	100
USA	37.1	37.8	36.0	33.0	31.2	30.9
EU	22.4	19.8	22.9	22.7	18.8	17.0
Japan	19.1	19.6	15.4	10.7	8.0	5.1
Brazil	1.2	1.4	1.1	1.7	1.9	1.7
Russia	0.7	0.3	0.5	0.9	1.1	1.2
India	0.4	0.3	0.5	0.7	0.9	0.8
China	3.4	4.0	8.1	14.5	23.4	27.3
South Africa	0.1	0.1	0.1	0.1	0.1	0.1
BRICS	5.9	6.1	10.4	17.9	27.4	31.1

Source: Calculation based on: National Science Foundation [2016].

Particular attention is drawn to the high growth rates of production and export of high-tech products in China in all analyzed sectors (HT, ICT sector and KTI services). China is the leader of HT-export (24,0%, 2014). For comparison, the share of the United States – 12.4%; EU – 18.3% [National Science Foundation, 2016]. It is noted that the growth rate of ICT sector in BRICS countries are significantly ahead of the growth rates of developed economies. But we should remember that these economic sectors in the countries of this group have national specific with their characteristics of education, requiring a differentiated researching. And the ways to the formation of ‘knowledge economy’ in the BRICS countries are completely different.

Conclusions

In the paper it was underlined that China play a crucial role in BRICS. However, BRICS are not perceived as a *sensu stricto* system [Szkutnik, 2016]. Index GCI is visible as important which is because of its explanatory character in terms of basic conditions, effectiveness factors or innovativeness factors. These factors are not influencing basic conditions of that index in significant way.

Despite impressive success of China and India, in BRICS, as a whole, the information technology development still lags behind the level of ICT usage in developed economies, and this reflects in the positions of these countries in the international rankings.

For generation of knowledge and technology with usage of all available BRICS opportunities, it is necessary to have a solid foundation for the formation of scientific and technological capacity. ICT penetration in all economic sectors and spheres of life is a key factor of scientific, technical and economic progress in the context of globalization.

In our deep conviction, Russia and other BRICS countries have a very significant potential for transformation and development. For the integration into the community of developed countries is needed supporting the high level of human capital. Solution of all these issues is urgent for BRICS countries. And they definitely will occupy in the future higher places in the international rankings of innovation development.

References

- Antipova E., Rodionova I. (2014), *Geography of Scientific Sphere in the Context of Globalization of the World Economy*, "Vestnik of the Belarusian State University (BSU), Series 2: Chemistry, Biology, Geography", No. 1, pp. 71-77.
- Galkin M., Rodionova I. (2013), *National Innovation Systems in the Context of the Internationalization of Research Activities* [in:] I. Rodionova (ed.), *Econ-Inform*, Moscow, p. 164.
- INSEAD and the World Intellectual Property Organization [WIPO] (2015), *The Global Innovation Index 2015: Stronger Innovation Linkages for Global Growth*, <http://www.globalinnovationindex.org/gii/> (accessed: 7.02.2016).
- National Science Foundation (2016), *Science and Engineering Indicators*, Appendix (tables 6). Two volumes, Arlington, VA, <http://nsf.gov> (accessed: 14.10.2015).
- Rodionova I. (2013), *Competitiveness of Countries in the World Innovation Economy: East-Central Europe and Russia*, "Quaestiones Geographicae", Vol. 32(2), pp. 15-24, www.degruyter.com/view/j/quageo.2013.32.issue-2/quageo-2013-0010/quageo-2013-0010.xml?format (accessed: 10.10.2015).
- Rodionova I. (2014), *World Industry in Post-Industrial Society: Tendencies and Regional Shifts*, "Miscellanea Geographica – Regional Studies on Development", Vol. 18, No. 1, 2014-03, pp. 31-36, <http://www.degruyter.com/view/j/mgrsd.2014.18.issue-1/issue-files/mgrsd.2014.18.issue-1.xml> (accessed: 10.12.2015).
- Rodionova I., Gordeeva A. (2010), *Human Development Index and Informatisation of Society in CIS*, "Bulletin of Geography, Socio-Economic Series", Vol. 13, pp. 79-87, http://www.bulletinofgeography.umk.pl/13_2010/06_rodionowa.html (accessed: 10.08.2015).

- Rodionova I., Kokuytseva T. (2011), *Current State and Development Prospects of the Russian Economy*, "Quaestiones Geographicae", T. 30. No. 2, pp. 23-34, <http://www.degruyter.com/view/j/quageo.2011.30.issue-2/v10117-011-0015-z/v10117-011-0015-z.xml?format=INT> (accessed: 10.01.2016).
- Szkutnik W. (2016), *Prognozowanie i symulacja kryzysów na przykładzie systemów reagujących na zmiany*, "Studia Ekonomiczne", nr 289, pp. 191-204.
- UNIDO and INDSTAT4 (2015), Industrial Statistics Database, 2015 edition at the 3- and 4-digit level of ISIC Revision 3, https://www.unido.org/data1/IndStatBrief/World_Leading_MVA.cfm?print=no&ttype=W6&Country=&Group (accessed: 16.02.2016).
- World Bank (2012), *Knowledge for Development: Knowledge Economy Index*, http://info.worldbank.org/etools/kam2/KAM_page5.asp (accessed: 7.05.2015).
- World Economic Forum (2015a), *The Global Competitiveness Report 2015-2016*, Geneva, <http://reports.weforum.org/global-competitiveness-report-2015-2016/report-highlights/> (accessed: 7.02.2016).
- World Economic Forum (2015b), *The Global Information Technology Report 2015, Networked Readiness Index 2015*, <http://www.weforum.org/issues/global-information-technology/gitr-2014-data-platform> (accessed: 27.01.2016).
- World Economic Forum (2017), *Agenda. What Is Competitiveness?* Geneva, <https://www.weforum.org/agenda/2016/09/what-is-competitiveness/> (accessed: 7.09.2017).

POZYCJE KRAJÓW BRICS W ŚWIECIE GOSPODAREK INNOWACYJNYCH

Streszczenie: Wskaźnikiem kształtowania się spolaryzowanego świata jest pojawienie się wielu nowych liderów – nie tylko regionalnych, ale również globalnych. W tym kontekście muszą być rozważane kwestie rozwoju BRICS i pozycji krajów do niego należących w gospodarce światowej. Celem tego artykułu jest wykazanie znaczącej roli Chin w grupie BRICS, która nie stanowi systemu *sensu stricto*. Artykuł skupia się na indeksie CGI. Przedstawiono także porównanie pozycji wiodących krajów gospodarki światowej i państw BRICS w międzynarodowych rankingach rozwoju innowacji.

Słowa kluczowe: BRICS, badania i rozwój, technologie informacyjne i komunikacyjne (ICT), gospodarka innowacyjna, rynki wschodzące, rankingi międzynarodowe.