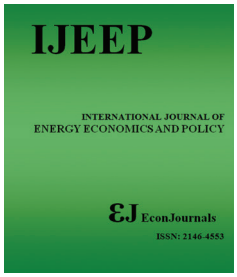

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Energy Safety and Innovative Development of the BRICS States

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ABSTRACT

In today's world, transition from a model based on the use of world resources by a limited number of developed economies (primarily the USA, Western Europe, etc.,), and on the redelivery of those to other regions and countries in the form of finished products and investments, to a multipolarity model is observed. Emerging new leaders, both regional and global, indicate formation of new centers of development. In this paper, the roles of BRICS member countries in the global economy are considered in context of multipolar world development process. For the further development of global economy, additional energy production is of great essence. However, power consumption efficiency and energy safety strategies move to the forefront in today's world. BRICS play an important role in the Global energy safety system, and their energy industry has a significant weight in both generation and consumption of world's power resources. The purpose of the article is to distinguish the BRICS position within the global power industry in dynamics from energy safety point of view, as cooperation in this field has great influence on the development and allows improving position of BRICS member countries in generating and export of industrial products and in general within the global economy. BRICS, the EU and NAFTA comparative analysis has been carried out based on the data provided by British oil and gas company British Petroleum (Statistical Review of World Energy, 2016), the United Nations Industrial Development Organization and the US National Science Foundation (Science and Engineering Indicators, 2016) over the period of 1999-2015.

Keywords: BRICS, NAFTA, The EU, Power Industry, International Ratings, R and D, Innovative Economy.
JEL Classifications: O10, O31

1. INTRODUCTION

The authors consider it useful and interesting to provide calculations based on statistic data from official sources regarding the EU, NAFTA and BRICS within multi-year dynamic trends. It should be interesting to research the changes of BRICS member countries in global power industry and manufacturing industry and their roles in global economy.

Different forms of cooperation seeking to meet the emerging challenges of the global economy and cooperation in the knowledge economy between BRICS member countries have been studied by experts from UNO regional committees (Bárcena and Prado, 2012). Relationships between BRICS and leading industrial countries, issues related to influence of BRICS member countries on international relationships, various issues of formation of multipolar global economy were researched by a number of Russian scientists and by foreign experts (Baumann, 2011; Hopenhain and Soho, 2012; Playdon, 2014) and others. As opined by numerous experts, the demographical, resource related and economical capacity of BRICS member countries allows the latter to become major economic systems before 2050.

Experts analyze economy modernization processes in a number of BRICS member countries, distinguish different aspects of development and cooperation in these countries, determine significance of internal growth, contribution into the global economy, issues related to expansion of financial markets and increase of commercial interaction within BRICS and with other countries (Bulatov, 2015). Special report made by Russian

scientists "prospects and strategic priorities of BRICS rising", presented at VII summit meeting of BRICS members in 2015 (Ufa, Russia) contained assessment of BRICS as a civilized association of a new format and comparative analysis and forecast for BRICS and G7 member countries development. Some researchers consider creation of the association from the point of positive effect on the global economy's development, emphasize strong points of each of BRICS member countries and stress on the original goal of the alliance: Improvement of BRICS advantages as a united market player (Rich, 2014). Others form an opposite opinion on BRICS as a hazard for the Western world, deeming current positions of this association as temporary.

The authors review BRICS member countries' positions in the global power industry, contribution of BRICS member countries into the global economy and their role in cooperation with the International Energy Agency (IEA). It should be mentioned that this paper continues a series written by the authors on BRICS's innovative development. Earlier papers covered on Russia's position in international ratings, comparison of Russia's positions against the Commonwealth of Independent States (CIS) member countries, countries of Central and Eastern Europe and leading economies of the world (Rodionova, 2013).

2. METHODS

The analysis methodology is based on system approach and comparative analysis principles. BRICS potential in global energy industry will be analyzed from the point of countries' shares in deposits, extraction and consumption of power resources of various nature as one of the main factors of industrial sectors' development of national economies; BRICS member countries' positions in the global innovative sector will be assessed via several international rating indices of innovative development; BRICS, the EU and NAFTA member countries' roles in manufacturing industrial products are comparatively analyzed in multi-year dynamic trend.

A number of international ratings were selected in order to identify and fix the readiness of world's countries to electronic economy and knowledge economy. They characterize features and levels of implementation of informational and communicational technologies (ICT) in different countries (Knowledge Economy Index, Digital Economy Readiness Index, ICT Development Index, global innovation index (GII), etc.) The selected international ratings were assessed for representativeness. Factors of correlation between values of the rating indexes of world's countries and individual values of their economic development (based on 4 values per capita: Gross domestic product (GDP), expenses on R and D, high-technology products gross value added, manufacture products and providing services of the ICT sector) were calculated. BRICS member states' positions in international ratings and in global industrial manufacturing field were compared with those of world's leading economies.

Numerous scientific works by Russian and foreign authors dedicated to analysis of issues and trends of development of R and D sector and BRICS member countries in general, as well as the authors' own scientific studies form a theoretical basis of this research. The study contains the information retrieved from materials provided by international organizations and scientific articles, reports by the World Bank, reviews and reports by UNIDO, publications of the US National Science Foundation (Science and Engineering Indicators, 2016) and others.

3. RESULTS

3.1. Findings: BRICS Member Countries' Positions in Global Energy Industry

The "oil era" gave a boost to intensive development of all industries of the global economy, which required, in its turn, increase of fossil fuel extraction and consumption. Along, in today's circumstances oil companies, including the ones of BRICS member countries, are interested in quick and large profits, and states as owners are interested in the most efficient possible extraction of deposits, rational and environmental friendly approach to utilization of natural resources. Thus, we can observe conflict of objectives that can be resolved, among other options, by means of introduction of innovative technology of oil recovery coefficient increase. BRICS member countries have to take under governmental control implementation of the state-of-the-art oil recovery coefficient increase methods, clearly determining required criteria, in order to achieve such an effect. Economic efficiency, ability to increase the oil recovery coefficient of oil deposits, high environmental safety should be among these criteria (Ageev and Chernyaev, 2012).

Information on actual oil deposits globally is based on the assessment provided by British Petroleum (Statistical Review of World Energy, 2016). As on the end of 2015, oil deposits capacity amounts up to 240 billion tons. Forecasted oil deposits of the planet are much larger. As experts of the IEA state, excess of oil on the global market will remain, as demand growth rates for oil decreases, and OPEC keeps extracting oil in maximum amounts. "Excess of oil will remain constant in 2017" (IEA, 2016). The Near East countries alone constituted 47% of the global deposits (OPEC countries' share is 71%) in late 2015. Even if one sums the shares of BRICS, the EU and NAFTA deposits, their total will represent less than 22%. Moreover, the share of BRICS member countries in global oil deposits has decreased from 11% to 8% in 1999-2015.

The EU and NAFTA shares in global oil deposits have also reduced. In NAFTA member countries (where the Canada holds the largest share of oil deposits - about 10% of the global value) it took place at the background of shale oil extraction rates growth in the USA, which has increased significantly in 2010-2015. This was the result of development of the technology, which allows reducing production cost, and enhancing recovery efficiency at the biggest shale oil deposits. However, since 2015 recovery of shale oil rates began to decrease due to low prices for oil on the global market and reduction of investments ("What should we expect from oil market in 2017?", 2017).

Saudi Arabia, the USA, Russia, Canada, and China (which is beforehand with Iraq, Iran, and UAE) were world's leaders in oil recovery rates as on the end of 2015. The EU member countries' share has always been small and it has decreased since 1999 from 5% to 1.6% (Table 1). NAFTA member countries' share

has increased up to 20% of the global value. The share of BRICS member countries has increased constantly. Growth from 16% to 21% has been observed due to increase of oil production rate in Russia (from 340 to 540 million tons after its reduction in the 1990s) and China (from 160 to 215 million tons).

The situation in global oil consumption is somewhat different. Back in 1999, the total share of the EU and NAFTA member countries constituted a half of the global consumption value (now this rate is as little as 37%). Decrease of proportion of countries included into the aforementioned economic associations in global oil consumption was accompanied by absolute consumption values reduction (in the EU, reduction from 710 to 600 million tons, and in NAFTA - from 1050 to 1036 million tons). Global oil consumption has increased 1.5 times over this period, the oil consumption in China has increased 5 times, in India - 3.5 times, and, respectively, BRICS's share in global oil consumption has increased from 15 to 25% for the given time interval (Table 1).

Changes in deposits, extraction and consumption landscape of primary energy resources (natural gas and coal) is illustrated in reports (Table 1). No significant changes with regard to natural gas are observed in proportions of these groups (BRICS share in world deposits was approximately 20% in 2015, that is more than the EU share, which is 0.7% and NAFTA one is about 7%). Russia directly accounts for 17% of the world's gas deposits. In terms of natural gas production, the situation differs, as the share of NAFTA (27%, including the share of the USA constituting 20% of the global value) exceeds the total share of BRICS (about 22%, including Russia's 16%). But, the volume of production is growing in almost all regions of the world (only in the EU the level of production has decreased twice, the countries of the region are importing natural gas). As to the consumption of natural gas, the situation is similar. In other words, the total deposits of natural gas in BRICS are about 20% of the world's value (production and consumption are approximately at the same level compared to the world's values).

Table 1: NAFTA, the EU and BRICS share change dynamics in the global energy industry classified by individual types of energy resources and electric power production (%)

Country groups	1999	2004	2006	2008	2010	2012	2015
Oil proved reserves							
NAFTA	18.2	16.4	16.0	14.5	13.5	13.6	14.0
The EU	0.7	0.5	0.5	0.4	0.4	0.4	0.3
BRICS	10.9	10.1	9.9	9.4	8.7	8.4	8.3
Oil production							
NAFTA	18.3	16.9	16.1	15.4	16.1	17.5	20.9
The EU	5.1	3.6	2.9	2.7	2.3	1.8	1.6
BRICS	16.0	19.3	20.2	20.6	21.8	21.6	21.3
Oil consumption							
NAFTA	29.5	29.0	28.2	26.6	25.5	24.3	23.8
The EU	20.0	18.5	18.3	17.6	16.3	14.8	13.9
BRICS	15.8	18.0	18.8	20.1	22.1	23.5	25.0
Natural gas proved reserves							
NAFTA	5.5	4.8	5.1	5.3	6.2	6.0	6.8
the EU	2.6	1.8	1.8	1.5	1.3	0.8	0.7
BRICS	24.4	21.4	21.5	20.8	20.1	19.8	20.1
Natural gas production							
NAFTA	32.1	27.7	26.6	26.1	25.6	26.6	27.8
the EU	9.8	8.4	7.0	6.2	5.5	4.4	3.4
BRICS	25.5	24.2	24.1	23.7	23.4	22.7	21.6
Natural gas consumption							
NAFTA	32.7	29.1	27.2	26.9	26.5	27.1	27.8
the EU	18.6	18.1	17.2	16.3	15.6	13.2	11.6
BRICS	17.7	18.0	18.8	18.8	19.4	19.9	19.9
Coal total proved reserves (total, all types)							
NAFTA	26.2	28.0	28.0	29.8	29.5	28.5	27.5
the EU	7.3	3.9	3.9	3.6	6.5	6.5	6.3
BRICS	42.3	46.6	46.6	44.6	42.5	42.5	41.4
Coal production (all types)							
NAFTA	23.1	18.9	17.7	16.5	14.3	12.2	11.3
EU	21.1	11.3	9.7	8.6	7.5	7.2	6.7
BRICS	46.3	53.3	55.6	57.7	61.2	63.1	64.3
Coal consumption							
NAFTA	22.8	20.8	18.5	17.2	15.5	12.4	11.8
The EU	20.4	11.2	9.9	8.6	7.7	7.7	6.8
BRICS	40.1	52.3	56.7	58.9	61.6	64.6	65.8
Electricity generation							
NAFTA	31.3	28.4	26.8	25.6	24.2	22.7	22.0
The EU	20.1	18.8	17.7	16.6	15.7	14.5	13.3
BRICS	21.5	23.2	25.6	30.1	32.6	35.2	37.7

Source: Calculated by the authors based on Statistical Review of World Energy, 2016

But the aspect where increase in the share of BRICS is especially noticeable is extraction and consumption of coal (about 65%), and this goes along with deposits counting slightly over 40% of the world's value. However, the largest aggregate reserves of all types of coal are located in the USA (27% of the world's deposits, both in black and brown coal), while in Russia this value is about 18% (deposits of brown coal are slightly higher - 20% of the world's value), in China coal deposits of all types are about 13% of the world's reserves (black coal deposits reach 15%). But China is leading in coal production (about 50%). In the EU, production halved in the 1990s and stable production was observed during the 2000s. In NAFTA, a slight decrease in the rates of production and consumption during the reported period was observed along with decrease of its share in the world's volume (from 14% to 7%). So, the analysis showed that BRICS member countries do not have such large deposits of energy resources and the fears of the world community about BRICS deposits are rather exaggerated.

Average indicators of proved oil deposits per capita in NAFTA are 10 times higher than those of BRICS (0.5 tons and 0.046 tons per capita respectively as on the end of 2015). The lowest rates were observed for the EU as a whole (0.01 tons of oil). When calculating oil reserves per capita for individual countries, the following findings were received: the USA - 0.17 tons, China - 0.01 tons, Russia - 0.7 tons. The average world oil reserves per capita are 0.23 tons (due to large deposits and a small number of residents in the Middle East).

But the level of natural gas reserves in 2015 in BRICS per capita is quite comparable to that of NAFTA, although it is higher than that of the EU, and coal reserves in NAFTA per capita are 4 times higher than in the EU and in BRICS.

It is interesting to compare not only the data on energy reserves per capita, but also on the production of electricity per capita in the economic groups under consideration as well. The results obtained show that the world's average value for 2015 is 3.3 thousand kWh annually, the average value for NAFTA is 10.87 thousand kWh, for the EU - 6.3 thousand kWh, for BRICS - 3.0 thousand kWh (so, the average value for BRICS is 2 times less than that of the EU and 3 times less than that of NAFTA). In the USA, the electric power production annually is 13.3 thousand kWh per capita, in Russia this value is 7.5 thousand kWh, in China - 4.2 thousand kWh, in Brazil - 2.8 thousand kWh, and in India - 1.0 thousand kWh. The difference is significant, though some progress in this area in BRICS member countries is evident. But in India, along with rapid population growth, this indicator has doubled, although the volume of production in the country has grown 2.5 times.

It is clearly seen that success of BRICS in global manufacturing industry is based not only on availability of mineral wealth deposits, but mostly on electric power production growth indicators (Rodionova and Gordeyeva, 2009). Along with the increase in electric power production in the world (1.6 times, up to 24 trillion kWh in 2015), and in the EU and NAFTA (1.1 times), the total BRICS value has increased almost 3 times since 1999 (up to almost 40% of the world's figure). At the same time, the volume of electric power production in China has increased almost 5 times during the analyzed period (up to 5,850 billion kWh in 2015, including Hong Kong), exceeding the EU total (3,230 billion kWh annually) almost 2 times, and even ahead the values of NAFTA (5,240 billion kWh annually). China is now the global leader (24%), having huge coal deposits, growing amount of oil deposits and large hydropower resources.

In India, electricity generation has exceeded 1,300 billion kWh as of 2015 (the third largest value in the world following China and the United States). Almost 50% of India's power supply comes from coal-fired power plants, and in general, over 80% of electricity is generated in thermal power plants.

Russia is the second country in the world for coal and natural gas deposits and one of three leaders in oil production. In 2015 Russia produced 1,064 billion kWh of electricity (the fourth position in the world). More than 60% of electric power is generated by thermal power plants. Other sources of electric power generation are the following: Hydroelectric power stations, nuclear reactors, and in lesser and clearly insufficient degree - other renewable resources (wind, solar, and tidal energy). It should be noted that renewable energy in Russia is still the youngest and smallest sector of the energy market (Oreshkina, 2017).

Brazil is the undisputed leader in the electric power industry of South America. In 2015, Brazil produced 580 billion kWh of electricity.

And the total share of BRICS now amounts to 37% of the world's electricity production (with a specific share of NAFTA and the EU reaching 22 and 13%, respectively) (Table 1).

4. DISCUSSION

4.1. Cooperation of BRICS Member Countries in Energy Industry

Cooperation in energy industry among BRICS member countries is being enhanced. Within the scope of mergers and acquisitions in 2010, Chinese corporation "Sinopec" ("China Petrochemical Corp.") has purchased 40% of shares in Brazilian branch of Spanish "Repsol YPF SA" company (third biggest oil producing company of Brazil, which possesses the biggest oil deposit within inter-American region recently discovered) ("Company News: Mergers and Acquisitions", 2011). In 2013 Chinese company "Sinochem" has purchased 35% of shares in Brazilian state oil company "Petrobras" in order to develop Parque das Conchas oil deposit. One of the branches of Indian company "Oil and Natural Gas Corp." (ONGC) also takes part in developing this offshore deposit. Chinese oil companies develop Libra deposit, one of the largest deep water oil deposits in the world.

In 2005, China acquired a share in Russian project Sakhalin-3: "China Natural Gas and Petroleum Corporation" (CNPC) purchased 49% shares of the oil and gas field development project in Irkutsk region. In 2013, CNPC entered into a partnership with "Rosneft" for a project to develop three offshore fields in Arctic. In 2014, CNPC and "Gasprom" entered into the largest in Russian history long-term (30 years' long) foreign trade

contract for gas supply to China, 400 billion USD worth, and supply scope is 38 billion m^3 of natural gas annually ("Russia and China have Entered a Gas Supply Contract", 2014). The largest investments of Chinese companies into Russian assets were the following: Purchase of 20% of shares in Yamal-LNG project from "Novatek" (estimated to reach 810 million USD). Investments of the "State grid corporation of China" into common projects with Russian state company "Sintez" are estimated as 1.1 billion USD worth.

In next 5 years, China intends to increase the amount of direct investment in Russia to 10 billion USD. China's participation in the Yamal LNG project (based on the South Tambey gas condensate field) will promote mutually beneficial Chinese-Russian cooperation in the fuel and energy sector.

According to the International Atomic Energy Agency (IAEA), China has caught up with Russia in the number of operating nuclear reactors. The first position as to this parameter is occupied by the USA (100 reactors), France (58) takes the second position, and Japan (43) is on the third position. China and Russia hold the 4^{th}-5^{th} positions (35 reactors each). China continues construction of 20 new reactors and plans major investments in renewable energy sources to 2020. Today in China, wind energy is one of the priority areas for the development of the energy industry (in 2016, the generation of electric power by wind power plants in China amounted to almost 150 GW, which is twice as big as the US figure).

According to an expert opinion, Russian concerns in partnership with foreign companies are in development of wind power generation: The Chinese corporation "Sinomec" will take part in construction of a wind power plant in Karelia, a Japanese company plans to build a wind power plant in Yakutia, etc.

Russia also carries out large-scale projects in the field of energy within BRICS. "Rosneft" has bought 49% of shares of the Indian oil company "Essar Oil". In next 20 years, Russia plans to build 12 nuclear reactors in India ("The Most Important Outcome of the BRICS Summit", 2016).

4.2. Change of the Current Background of the Global "Scientific Landscape"

In developed economies, expenditures on research are 2-3 times higher than in developing ones. In the structure of world's GDP, the share of R and D expenses is estimated at about 2% (due to the indicators of economically developed countries). North America, Europe and East Asia are three world's main R and D areas. But China is today emerging as a new actor in the three-dimensional space of R and D (the USA - the EU - Japan).

Calculations made by the authors confirm the leadership of North America and Europe in many aspects. But there are also significant changes in figures related to the countries of the Asian region, including due to values of Japan, China, India and the countries of "new industrialization" (the Republic of Korea, Singapore, etc.). The share of Asia has risen up to 37% of the world's total. China has reached 14% of the world figure, Japan's share has decreased down to 11%, and the share of India has grown up to 3%.

Modernization of production and infrastructure, technical re-equipment, growth of the total share of R and D expenditures in BRICS member countries along with the growth of their GDP volumes are shown in the Table 2.

The USA has been leading in R and D expenditures field in global scale (30% of world expenses, 453 billion USD, 2014) for a long time. It is important that China occupies the second position (about 377 billion USD). The costs of other countries are lower: Japan - 160 billion USD, Germany - about 100 billion USD, the Republic of Korea, France, India and Russia - 1% of GDP, about 40 billion USD.

In China in 2002 - 2014, the share of R and D expenses in the country's GDP increased more than threefold, from 0.7% to 2.1% (China has got the first position in GDP, ahead of the USA). During this period, expenditures on research and development increased 10-fold: From 39 to almost 400 billion USD. However, per capita expenditures in China and other BRICS member countries remain far behind the leaders (the USA - 1,430 USD, Japan - 1,260 USD, China - 240 USD, India - about 90 USD).

Table 2: Expenses related to R&D, 2009-2014 (in current prices)

Country	Expenses related to R and D, billion USD			Expenses related to R and D per capita, billion USD	
	2009	2014	2014 (% of GDP)	2009	2014
Leaders					
The United States of America	406.0	453.5	2.8	1312.0	1428.0
China	184.2	336.6	2.1	136.3	242.9
Japan	136.9	160.2	3.5	1075.4	1260.4
Germany	82.8	101.0	2.85	995.7	1220.8
The Republic of Korea	46.0	68.9	4.2	954.8	1399.4
BRICS member countries					
China	184.2	336.6	2.1	136.3	242.9
India	39.4	48.1	0.8	33.1	39.4
Russia	34.6	40.7	1.1	241.2	284.9
Brazil	28.4	35.8	1.2	146.8	180.1
South Africa	4.8	4.8	0.7	94.7	92.1
BRICS total	291.4	466.0			

Source: UNESCO Science Report, 2015: Towards 2030. Paris. 2015. (DoA: 10.03.2017)

4.3. Calculations and Correlation Coefficients

The analysis of the positions and role of the BRICS countries in the world energy sector cannot reflect in full all developmental factors of these countries and the positions they occupy in the world economy and in innovative development. The availability and use of energy resources do not yet guarantee the high status of countries in the world economy. More important factors today are peculiarities of innovative development, factors of power generation and use of knowledge, new technologies and innovative infrastructure. These factors are necessary for existence within the framework of the new development paradigm "Industry 4.0", which is widely discussed and applied in highly developed countries.

Criteria and figures of different ratings reflect the peculiarities of influence of the scientific and technological achievements on the economic development of the countries. The authors have carried out calculations of correlation coefficients between the pairs of indicators in order to assess representativeness of the ratings used for ranking the countries of the world.

Based on calculation of the correlation coefficients, a direct correlation was established between the figures of the countries of the world in the rating tables of various indexes (Knowledge Economy Index, Knowledge Index, Networked Readiness Index, GII and others). The coefficient obtained is about 0.9. This means that they are all interchangeable and applicable to the analysis of the situation with innovative development in the countries of the world, and the evaluation criteria used in them adequately reflect features of innovative development.

Correlation calculations were also performed, having shown a high direct correlation between values of the countries in each rating table for any Index and several economic figures of the same countries. The values of the indices in the rating tables were then compared with the volume of production of high-tech industries in the countries per capita, as well as the output of the ICT sector products per capita in different countries. And the last calculation of the correlation coefficient reflects a ratio between positions of different countries in the rating tables and their R and D expenses per capita.

The revealed high dependence (correlation ranging from 0.6 to 0.9) indicates the following. All analyzed Integral Indices reflect the features of innovative development of countries and their differences. It is noted that only the countries with the highest level of social and economic development will be able to develop the electronic economy.

4.4. BRICS Member Countries' Positions in International Ratings

4.4.1. Knowledge economy index

Knowledge Economy Index was calculated by the World Bank's experts under "The Knowledge Assessment Methodology". It is created in order to assess countries' ability to create, apply and distribute knowledge. Analysis of the summarized index - Knowledge Economy Index and its constituents - appear to be important and interesting ("Knowledge for Development: Knowledge Economy Index and World Bank", 2012). Table 3 shows information on the four constituent parts of the Knowledge Economy Index.

Small countries of Western Europe - Sweden, Finland, Denmark, the Netherlands, Norway, which are famous for the high pace of innovation economy are leading in this competition. Russia occupies the 55th position out of 145 in the integral index of the knowledge economy rating. Other countries of the BRICS are even lower in the rating: Brazil occupies the 60th position, South Africa - the 67th, China - the 84th, India - the 109th.

Many of the countries of Central and Eastern Europe are ahead of Russia in this rating - the Czech Republic, Poland, Slovakia, Croatia, Romania, and Bulgaria. The CIS countries occupy lower positions - from the 56th for Ukraine to the 106th for Tajikistan. The lowest indicators in Russia in this regard are the ones related to the development of its institutional system. In China and India, lowest indicators are the ones related to the following positions: Institutional system, education, use of information technology, in South Africa - the ones related to the use of ICT.

4.4.2. GII (The GII, 2015)

This index comprises two sub-indexes. The information with regard to 140 countries on 80 indicators demonstrates an analysis of global trends in innovative development. According to the GII rating as for 2015, China is ranked the 29th (the 35th in 2013), Russia - the 48th (the 62nd in 2013), South Africa - the 60th (the 58th in 2013), Brazil - 70th (64th in 2013), India - the 81st. Leading countries of the rating are Switzerland, the United Kingdom, Sweden, the Netherlands, the USA, Finland, Singapore, Denmark, Luxembourg, Hong Kong, Ireland. Japan occupies the 19th position among 143 countries.

4.4.3. ICT development index

The number of mobile broadband connections in the world has increased from 0.8 billion in 2010 to about 3.5 billion by 2015 (Measuring the Information Society Report, 2015). The Republic of Korea, Denmark, Iceland, the United Kingdom, and Sweden remain on leading positions in this ranking. Japan occupies the 11th position, the USA is on the 15th. Russia occupies the 45th position, Brazil - the 61st, South Africa - the 88th, India - the 131st (out of 167 countries).

4.4.4. Networked readiness index

The Networked Readiness Index assesses the quality of digital infrastructure and ability to use ICT to support economic growth, stimulate innovation and improve the welfare of its citizens (The Networked Readiness Index, 2015). It is measured against a scale from 1 (the worst) to 7 (the best), calculated on the basis of three sets of data: 1) the availability of networking infrastructure; 2) willingness to use it in civil society, business and government structures; 3) the real level of ICT application. The components of this index reflect key factors that influence the development of information technologies.

It is important to carry out a detailed analysis of the positions of different countries in the ratings with regard to individual components of the Index. These indicators reflect, in general, levels

of education of the population, social resources, development of e-commerce, and overall infrastructure of the country.

Singapore, Finland, Sweden, the Netherlands, Norway, and Switzerland are the leading countries in this rating. The USA occupies the 7th position, Japan - the 10th position out of 143 countries. It is important to note that China is on the 35th position in the rating in 2015, followed by Russia (the 41st), South Africa (the 75th), Brazil (the 84th), and India (the 89th).

4.4.5. Global competitiveness index

The Global Competitiveness Index, 2015-2016, has been calculated for 140 countries (ranging from 1 to 7) (The Global Competitiveness Report, 2015-2016, 2015). Positions of countries by the basic conditions of development, factors of efficiency and innovation (113 variables, detailing the competitiveness of countries in the global economy) are assessed (Table 4).

The group of leaders traditionally includes Switzerland, Singapore, Finland, Germany, the USA, Sweden, the Netherlands and other developed economies. It should be noted that China occupies the best position among other BRICS member countries. In the rating of 2010-2011 Russia took the 63rd position, and now it is the 45th.

4.5. Positions of Countries with Regard to Manufacturing of Industrial Products

The issues of introduction of innovative technologies into industrial production, enhancement of innovative activity, attraction of financial resources, and promotion of knowledge-intensive products to the world market are being solved in the BRICS member countries. The data illustrate changing of the positions of the leading countries in the global manufacturing industry (Table 5).

The share of China in the global manufacturing industry has increased from 11.7 in 2005 to 23.8% in 2015 (in prices of 2010). According to the information provided by another statistical database, where calculations were made at current prices (the US National Science Foundation - Science and Engineering Indicators, 2016) as early as in 2014 China ranked the first in the world in industrial products manufacturing (25.6% of the world volume). For reference: The USA reached 18.3%, Japan - 7.2%, Germany - 6.1%, and the Republic of Korea - 2.7% (Science and Engineering Indicators, 2016).

In China, steel production accounts for more than 50% of the world index in 2015 (the first place in the world), primary aluminum production - about 55% of the world's volume (1st position), cement production - about 57% of the world's volume, production of passenger cars - the first place in the world (21.1 million - about 30% of the world quantity), etc.

The comparative analysis performed has shown an increase in the share of BRICS member countries in the global industrial production volume compared to NAFTA's and the EU's figures. The total manufacture of industrial products in BRICS member countries amounted to one third of the world volume in 2014 (in current prices). This is higher than the total output demonstrated by the countries of NAFTA (21.6%) and 28 countries of the EU (20%). Although in 1999 the total share of BRICS member

Table 3: The knowledge economy index and its constituent parts, 2012: Leading countries and BRICS member countries

No	Country	Knowledge economy index	Knowledge index	Constituent parts of the index			
				Institutional regime	Innovations	Education	ICT
1	Sweden	9.43	9.38	9.58	9.74	8.92	9.49
2	Finland	9.33	9.22	9.65	9.66	8.77	9.22
3	Denmark	9.16	9.00	9.63	9.49	8.63	8.88
4	The Netherlands	9.11	9.22	8.79	9.46	8.75	9.45
5	Norway	9.11	8.99	9.47	9.01	9.43	8.53
60	Brazil	5.58	6.05	4.17	6.31	5.61	6.24
67	South Africa	5.21	5.11	5.49	6.89	4.87	3.58
84	China	4.37	4.57	3.79	5.99	3.93	3.79
109	India	3.06	2.89	3.57	4.50	2.26	1.90
55	Russia	5.78	6.96	2.23	6.93	6.79	7.16

Source: Compiled by the authors based on data provided in the article "knowledge for development: Knowledge economy index". World Bank (DoA: 07.05.2015)

Table 4: Global competitiveness index: Leading countries and BRICS member countries

Position	Country	Index	Position	Country	Index
2010-2011			2015-2016		
1	Switzerland	5.63	1	Switzerland	5.76
2	Sweden	5.56	2	Singapore	5.68
3	Singapore	5.48	3	The United States of America	5.61
4	The United States of America	5.43	4	Germany	5.53
5	Germany	5.39	5	The Netherlands	5.50
27	China	4.84	28	China	4.89
54	South Africa	4.32	45	Russia	4.44
58	Brazil	4.28	49	South Africa	4.39
51	India	4.33	55	Brazil	4.31
63	Russia	4.24	75	India	4.08

countries constituted just 10%, the share of NAFTA countries was almost 32%, and that of the EU's one - almost 28% (Table 6).

Obvious increase in the value of BRICS in the global industry occurred primarily due to the growth of China's indicators. The total volume of production in China in 1999-2014 has increased (in current prices, according to the Science and Engineering Indicators - 2016 database of the US National Science Foundation) from 30 to 486 billion USD (almost 16 times), while in the US this value has grown from 320 to 511 billion dollars (i.e. just 1.6 times). The world output of scientific and technology industries (in current prices) as for the period 1999-2014 increased from 863 billion USD to 1.78 trillion USD (i.e. just twice). The share of BRICS member countries in the world production of the said high-tech products has increased from 5.9% to 31.1% during the period under consideration, the share of NAFTA has decreased from 40% to 31%, and the share of the EU member countries - from 22% to 17% (Table 7).

The total share of the three largest economic groups (NAFTA, the EU and BRICS) in the world manufacture of high-tech products for the period 1999-2014 has increased from 2/3 to 4/5. However, it is worthy to note that the growth rates of the scientific and technological and ICT sectors in BRICS exceed greatly those of the developed economies.

5. CONCLUSION

Based on the study conducted, the strengthening of the positions of BRICS member countries in the world industry is distinguished, including due to the availability of energy resources in their territories, which means complication of the territorial structure of the global economy and increasing importance of BRICS.

The analysis showed that the level of deposits, production, and consumption of the main energy resources in BRICS is not as high and is quite comparable with NAFTA's figures. But taking into account that BRICS member countries possess more than 40% of the world's population, these per capita figures are comparable even to those in the EU.

However, BRICS countries' dynamic trend of the industrial products manufacturing share in production and exports volume (including high-tech) has shown quite high growth rates. At the same time, the total share of five BRICS states is often higher than figures attributed to both 28 EU member countries, and 3 NAFTA member countries. Refuting the dominating opinion, this situation is determined not only by the energy resources available in countries. The main factors are sound economic policies, development of science and technology, introduction of scientific and technical cooperation, etc., But the analysis showed a lag in the development of information technologies in BRICS countries compared to the level of ICT in developed economies.

BRICS member countries have different economic performance; the rate of their development varies drastically. But, despite all difficulties, they continue to develop consistently. At the same time, interests of BRICS (an association that does not have the status of an international organization) member countries are based on the intention to strengthen their positions in global financial and economic structures, to improve their powers in decision-making within the international framework. Attempts made by BRICS to reform the global economic order are impossible without strengthening their positions in different fields of activity and sectors of economy.

Table 5. Leading countries of the world manufacturing industry (share in world production volume, % (in fixed prices of 2010)

Country	2005	2010	2015
China	11.75	18.69	23.84
The United States of America	20.43	17.77	16.54
Japan	11.14	10.43	8.93
Germany	7.29	6.55	6.37
The Republic of Korea	2.54	2.95	3.09
India	1.74	2.36	2.45
Italy	3.70	2.94	2.42
France	3.13	2.61	2.34
Brazil	3.08	2.89	2.26
Indonesia	1.65	1.70	1.93
The United Kingdom of great Britain	2.66	2.15	1.93
Russia	2.15	1.90	1.77

Source: Compiled by the authors based on data provided in INDSTAT4-2016 edition. Industrial Statistics Database (DoA: 15.01.2017)

Table 6: Dynamic trend of BRICS member countries' and economic unions' shares change in the global industrial products manufacture volume (%)

Country groups	1999	2004	2006	2008	2010	2012	2014
NAFTA	31.9	28.2	27.4	23.1	22.2	21.4	21.6
the EU	27.8	28.9	27.2	27.0	22.1	19.8	20.1
BRICS	10.2	14.3	18.0	23.4	27.8	31.0	33.8
World	100	100	100	100	100	100	100

Source: Calculated by the authors based on data provided in science and engineering indicators - 2016. Appendix [Tables 6]. Two volumes. Arlington, VA: National Science Foundation, USA, 2016

Table 7: Dynamic trend of BRICS member countries' and economic unions' shares change in the global manufacture of high-tech products, 1999-2014 (%)

Country groups	1999	2004	2006	2008	2010	2012	2014
NAFTA	40.4	36,0	35.2	33.0	33.8	31.3	30.9
The EU	22.4	22.9	22.3	22.7	18.1	16.8	17.0
BRICS	5,9	10,4	14.2	17.9	22.0	27.4	31.1
World	100	100	100	100	100	100	100

Source: Calculated by the authors based on data provided in science and engineering indicators - 2016. Appendix [Tables 6]. Two volumes. Arlington, VA: National Science Foundation, USA, 2016. DoA: 10.02.2017

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