

Structural Changes in the Economy of Cross-Border Regions of Russia and China

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ABSTRACT

The article examines the structural changes in the Russian and Chinese regions involved in the processes of cross-border cooperation. The resulting quantitative assessments indicate that the most noticeable structural changes in all Russian regions took place during the period from 2009 to 2013. At that, their value exceeds the changes observed in average in the Russian Federation as well as in neighboring border regions of China. In the Chinese provinces, significant structural changes are observed for the entire period of time under study. It is revealed that the qualitative aspects of structural changes are not the same: While in China proportion of services, including the financial sector, increases, the regions of the Russia are mainly extending the proportion of extractive industries. We conclude about the possible impact of cross-border relations on the dynamics of sectoral changes in the regions of the Russia, whereas Chinese provinces are less dependent on this factor.

Keywords: Region, Cross-border Cooperation, Russia, China, Structural Changes

JEL Classifications: O40, O57, R11

1. INTRODUCTION

In recent years, the initiative of the Silk Road Economic Belt specified by People's Republic of China (PRC), attracted increased attention of the Russia (Russian Federation [RF]) and its eastern regions. In accordance with this concept, the strategic interests of China are significantly beyond the country's borders and focus on the territories of Asian, European and African countries in the form of a "large-scale regional cooperation." In the framework of the cooperation, in addition to political and trade freedoms as well as transportation lines, a certain trade and investment area is designated that serves the foundation of the project. Investment cooperation involves the invitation of the "belt" member countries to invest in production projects in China, as well as the active participation of Chinese companies in the industrial and agricultural production in these countries, including construction of infrastructure; at that, one of the focuses is made on the differentiation of labor and the use of opportunities and management offered by the Chinese party.

Such a large-scale project, which according to studies (Dong et al., 2015) will cover about 43% of the world area and 66.9% of the world population, will affect the economy of the member countries, and in the case of the RF, a certain effect will be on the border regions of Siberia and the Far East. It is these regions, which during the recent years are being involved in the projects of cross-border cooperation with China. In this regard, various aspects of Russian-Chinese relations are currently discussed by the scientific community. In particular, the work (Glazyrina et al., 2011) presents the analysis of the borderline effect on the investment processes and reveals that this effect does not change the general trend of the backlog of identified regions from the national average. The works (Glazyrina et al., 2014; Zabelina and Klevakina, 2011) discuss environmental and economic aspects of interaction and show that the eco-intensity of economic activities in the Russian regions is significantly higher in terms of some indicators than in the regions of China that means that Russia has a higher level of negative impact on the natural environment per unit of the generated value added. Thus, the rational management

of the processes taking place in the framework of cross-border relations is currently an objective necessity. In this regard, the main purpose of this study is to identify and analyze the structural changes in the economic systems of the regions in the context of cross-border cooperation.

The formation of the conceptual issues of the theory of structural changes begins with the works represented by various economic schools – A. Smith, K. Marx, R. Stone, J. Keynes and others. Among contemporary studies on structural changes, there are a large number of both theoretical and empirical works. Theoretical works are related to the development of methodological foundations and measurement methods of the observed transformations (Esteban-Marquillas, 1972; Arcelus, 1984; Spasskaya, 2003). The empirical research is focused mainly on a quantitative assessment of the changes taking place in the global economy (Memedovic, 2010), national economies (Ehmer, 2011; Luukkanen et al., 2015; Miheeva, 2013) as well as in the individual regions (Aralbaeva and Afanasiev, 2011; Elhina, 2014) or sectors (Shi and Yang, 2008; Schmidt, 2014). Some researchers are focused on the study of the relationship between structural changes and other processes. For example, Fan et al. (2003) explores the relationship between structural changes and economic growth, while Urraca-Ruiz (2013) considers structural changes and the state of the art. Much attention is paid to modeling of structural changes using conventional (Chen, 2015; Stock and Watson, 1996; Hansen, 2001) and non-conventional approaches. For example, Stijepic (2015) proposed a geometric approach to structural change modeling. He showed that the observed change in the employment of a three-sector economy is path-dependent, and used this fact to reduce significantly the number of future structural change scenarios, taken into account when developing policy and strategic documents by the public authorities.

In this article, based on empirical data, we will perform dynamic analysis of structure indices and their differences in the context of cross-country comparisons of economic systems of the regions involved in cross-border cooperation between Russia and China, using several of the most common indicators.

2. RESEARCH AREA

In this paper we make emphases on the analysis of changes taking place in the reproduction and specialization structure of economic systems in the regions involved in cross-border cooperation between Russia and China (Figure 1), namely, Trans-Baikal Territory, the Republic of Buryatia, the Irkutsk Region, the Amur Region, the Primorye Territory, the Khabarovsk Territory, the Jewish Autonomous Region, Inner Mongolia and Heilongjiang provinces. English names of the regions are presented in accordance with the official translation of Russian Constitution (2016:21).

Such a focused attention to the selected regions is given due to their intense involvement in bilateral economic relations. One example illustrating this phenomenon is the adoption in 2009 of the Program on cooperation between the Russian Far East and Eastern Siberia of the RF with the North-East of the PRC (2009-2018).

3. RESEARCH METHODS

The study of the structural differences and changes in national and regional economies was performed using several most common indicators: Gatev integral coefficient, Salai index of structural changes, Ryabtsev criterion, and Herfindahl index (Aralbaeva and Afanasiev, 2011; Miheeva, 2013). The index of structural changes proposed by the Hungarian scientist Salai takes into account the intensity of differences in the proportion of individual groups, the proportion of correlated pair of groups in comparable structures, and the number of selected categories. The following formula is used to calculate Salai index:

$$I_s = \sqrt{\frac{\sum_{i=1}^n \left(\frac{d_1 - d_0}{d_1 + d_0} \right)^2}{n}} \quad (1)$$

Where, d_1 and d_0 – are the proportions of the aggregate in the reporting and base periods; n – is the number of groups.

Gatev integral coefficient takes into account the intensity of differences in the proportions of individual groups, and the proportion of correlated pair of groups in comparable structures. It is calculated by the following formula:

$$I_G = \sqrt{\frac{\sum_{i=1}^n (d_1 - d_0)^2}{\sum_{i=1}^n (d_1^2 - d_0^2)^2}} \quad (2)$$

Ryabtsev criterion does not significantly differ from the Gatev integral coefficient. It is calculated as follows:

$$I_R = \sqrt{\frac{\sum_{i=1}^n (d_1 - d_0)^2}{\sum_{i=1}^n (d_1 + d_0)^2}} \quad (3)$$

The Salai, Gatev and Ryabtsev indices were calculated for the entire reporting period (2004-2013) and the period since the global financial crisis (2009-2013). Besides, the annual variations of the indices were calculated as well. To interpret the obtained results, we used the rating scale of the significance of structural differences, developed for the Ryabtsev criterion (Elhina, 2014), which can be used to assess the degree of significance of the structural changes (Table 1).

For regional economies, along with these indices, we calculated Herfindahl index or market concentration index, which can be used to assess the economic diversification (Miheeva, 2013):

$$I_H = \sum_{i=1}^n d_i^2 \quad (4)$$

This index varies between 0 (in this case a national or regional economy is represented by many sectors, at that each of them contributes a minor proportion to the overall index) and 1 (in this

Figure 1: Regions involved in cross-border cooperation between Russia and China**Table 1: Rating scale of the significance of structural differences according to the Ryabtsev criterion**

The range of Ryabtsev criterion (I_R)	Characteristic of significance of structural differences
0-0.030	The identity of structures
0.031-0.070	Quite low level of diversity of structures
0.071-0.150	A low level of diversity of structures
0.150-0.300	An essential level of diversity of structures
0.301-0.500	A significant level of diversity of structures
0.501-0.700	A very significant level of diversity of structures
0.701-0.900	The opposite type of structures
0.901-1	The direct opposite structures

case a national or regional economy is represented by only one sector).

The above considered indices have certain advantages and disadvantages. Persteneva (2012) analyzed the specific features of these and other statistical indicators and proposed the classification based on several criteria: Normalization, cross-functionality, sensitivity and focus (Table 2).

To assess structural differences and changes we utilized the annual data on gross domestic product (GDP) and GDP in regions for the period of 2004-2013, as reported in the annual volumes of the Russia and China Statistical Yearbook and obtained by the Federal State Statistics Service of Russia and National Bureau of Statistics of China. It should be noted that the data of the National Bureau of Statistics of China have some differences from those calculated

in the Russian practice. In particular, indicators characterizing the sectorial structure of the national economy and certain regions of the RF are represented in terms of major economic activities. Chinese statistics uses the sectorial structure of the economy, which involves the allocation of three sectors: Primary (includes industries associated with the extraction and primary processing of raw materials: The extraction of natural resources, agriculture, forestry, fishing, and hunting), secondary (manufacturing sector and construction), and tertiary (service industry) (Clark, 1940). Compared to the traditional approach (Clark, 1940), the statistical information database available from National Bureau of Statistics of China, attributes to primary industries only agriculture, hunting, fishing and forest industry, while the secondary industries include extractive and manufacturing industry, as well as the production of electricity; construction is regarded as a separate industry, while the rest of the activities belong to the service sector. Thus, to achieve comparability of the results, the Rosstat (The Federal Service of State Statistics) data was grouped according to the sectorial structure of the Chinese economy. It should be noted that due to the lack of information necessary to account for inflation (particularly, the lack of price indices at the level of individual types of economic activity in the regions of the PRC) we used in computations the gross domestic (regional) product, calculated in current basic prices.

4. FINDINGS AND DISCUSSION

The analysis of the sectorial structure of the economy in the regions involved in cross-border cooperation between Russia and China,

Table 2: Properties of the indices indicating structural differences and changes

Criterion	Gatev integral coefficient (I_G)	Salai index of the structural changes (I_S)	Ryabtsev criterion (I_R)	Herfindahl index (I_H)
Normalization: The value is within the range from 0 to 1	0 – “Identity of structures,” 1 – “Complete difference of structures”	0 – “Identity of structures,” 1 – “Complete difference of structures”	0 – “Identity of structures,” 1 – “Complete difference of structures”	0 – “Low-concentrated markets,” 1 – “Highly concentrated markets”
Cross-functionality is considered in the spatial-temporal aspect, which means the use for the analysis of structural differences (in space) and structural shifts (over time)	Cross-functional	Cross-functional	Cross-functional	Does not account for changes in time
Sensitivity is understood as the elasticity of a certain indicator depending on the change of the specific weights of the studied aggregates	Can be calculated in any case	Cannot be calculated if the proportions in each period of any group are equal to 0	Can be calculated in any case	Can be calculated in any case
Focus is defined as a development vector, positive or negative structural changes	Specifies the presence of structural changes and their values	Specifies the presence of structural changes and their values	Specifies the presence of structural changes and their values	Specifies the dominance of certain industries in the region

has shown that in 2004 the structure was characterized by the following parameters:

- The proportion of primary sector in the regions of the RF ranged from 7.5 (Trans-Baikal Territory) to 14.5% (Jewish Autonomous Region);
- The proportion of secondary sector in the regions of the RF significantly varied from 15.3 (Trans-Baikal Territory) to 32.7% (Irkutsk Region);
- The proportion of the tertiary sector ranged from 33 to 42%;
- In the regions of China, the primary sector accounts for 12-17%, secondary – for 41-52%, and the service sector – for about 30%.

By 2013, the economic structure has transformed as follows:

- The proportion of primary industries, except extractive sector, has significantly reduced (by 1.5-2 times) in all regions;
- A significant increase in extractive industry was noted in some regions, for example, in Trans-Baikal Territory, Irkutsk Region and Republic of Buryatia;
- A significant reduction in proportion of the secondary sector (by 1.2-1.5 times) was noted in Khabarovsk Territory and Primorye Territory;
- An increase in services (by 1.1-1.2 times) was noted in all regions with the exception of Trans-Baikal Territory;
- The border regions of China are characterized by different trends: Thus, in the Heilongjiang province, the proportion of primary sector has increased by 1.4 times, the services sector has also slightly increased, while secondary sector has decreased by 0.8%; in Inner Mongolia, the proportion of secondary sector has increased by 1.3 times, whereas the proportion of primary sector has decreased by 0.6%.

Some transformations were noted in the tertiary sector as well. Thus, in China there was increase in proportion of other services, which include spending on education, health care, etc., while

in Russia this volume, expressed in percentage of gross rating point (GRP), is reduced and accounts for 70-90% as compared to that in 2004 (Figure 2). The situation is similar in financial sector – there is 1.8-5.7 fold growth in China, while in Russia, this already small enough volume is reduced and makes up 40-90% of the 2004 level.

Let us dwell on the situation in the financial sector – its proportion in the GRP structure of the RF regions is minimal. The lack of long money in the state economy and the inability of the regulator to fix somehow current situation (Aganbegyan, 2015) leads to the fact that major Russian companies prefer to borrow investment loans in foreign banks, including those in China. The refinancing rate, approved by the People’s Bank of China, is 5.35% versus 8.25% in Russia. Whereas, Russian banks in the regions, when lending primarily to the population and small companies are poorly involved in creation of gross value added (0-0.3%). Inner Mongolia, which is not the most developed province in China, provides about 3.3% of GRP at the expense of the financial sector, and this proportion continues increasing (Figure 3).

Table 3 presents the indices of structural changes, calculated for the regions of cross-border cooperation between Russia and China. In the pre-crisis period (2005-2007) the structure of reproduction in most of the regions was not subjected to changes, the only exception is the Amur Region and Trans-Baikal Territory (2005-2006, 2006-2007), in which Salai index is high enough: 0.34-0.35. During the financial crisis (2008-2009) there has been a remarkable transformation in almost all regions: The weakest changes were noted in the Khabarovsk Territory and the Primorye Territory, while the most essential changes were in the Republic of Buryatia and the Jewish Autonomous Region. For the considered time interval, there were slight structural changes at the national level: All indices in most cases do not exceed 0.1 (quite low level of differences in structures).

Figure 2: The value added by sectors (value added is calculated at current prices). (a) The Russian Federation, (b) China

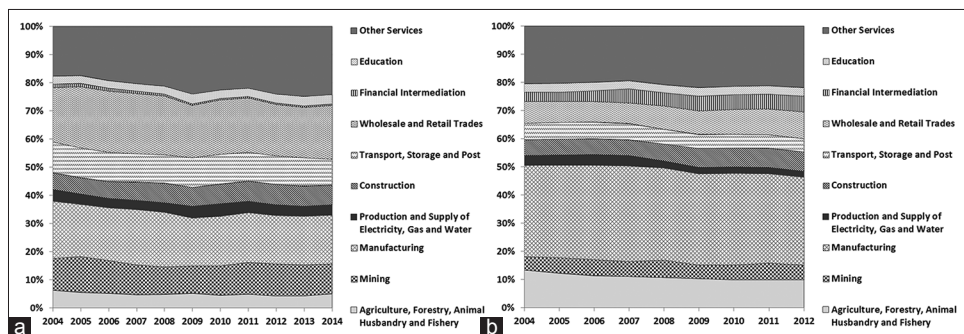


Figure 3: The change in proportion of individual industry sectors in gross regional product in Russia and China (in percentage points), 2004-2013. (1) China, (2) Inner Mongolia, (3) Heilongjiang, (4) Russia, (5) The Republic of Buryatia, (6) Trans-Baikal Territory, (7) The Irkutsk Region, (8) The Primorye Territory, (9) The Khabarovsk Territory, (10) The Amur Region, (11) The Jewish Autonomous Region

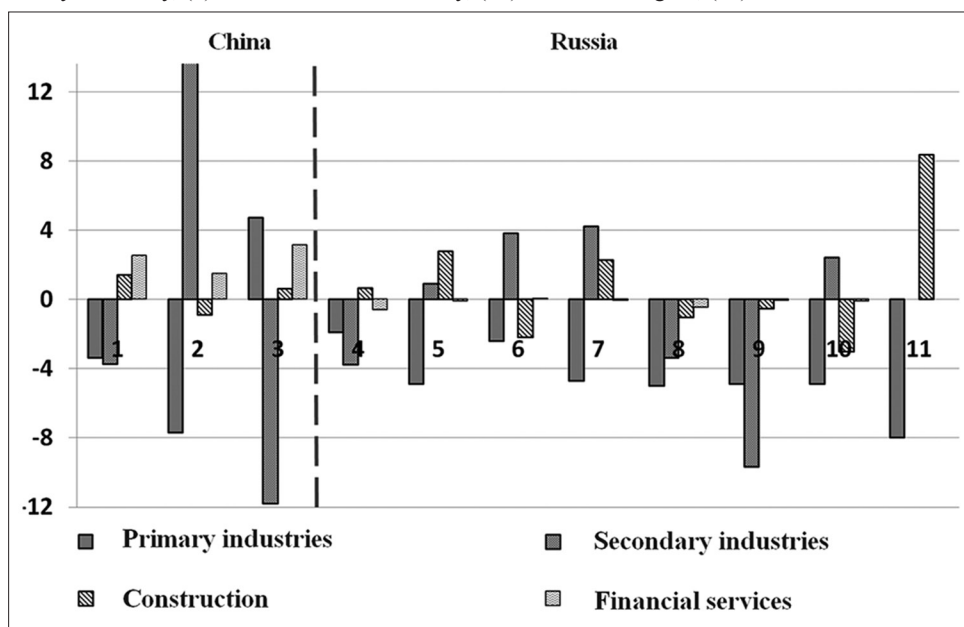


Table 3: Salai index

Region/Country	2005/2006	2006/2007	2008/2009	2011/2012	2012/2013	2004/2013	2009/2013
The Jewish Autonomous Region	-	-	0.34	0.34	0.36	0.37	0.38
The Amur Region	0.35	0.34	0.25	0.09	0.14	0.38	0.37
The Khabarovsk Territory	0.10	0.12	0.13	0.09	0.07	0.16	0.18
The Primorye Territory	0.06	0.08	0.14	0.17	0.12	0.19	0.24
The Irkutsk Region	0.11	0.09	0.27	0.05	0.06	0.23	0.36
Trans-Baikal Territory	0.34	0.03	0.27	0.03	0.12	0.35	0.32
The Republic of Buryatia	-	-	0.36	0.07	0.10	0.40	0.39
Russia	0.03	0.05	0.18	0.03	0.03	0.14	0.09
Heilongjiang	0.10	0.09	0.09	0.07	0.03	0.27	0.09
Inner Mongolia	0.03	0.05	0.10	0.02	0.02	0.17	0.04
China	0.03	0.04	0.04	0.01	0.02	0.13	0.04

Source: The authors' calculations

Subsequent annual changes in the structural proportion are less noticeable (except the Jewish Autonomous Region) in comparison with the changes in the crisis period (2008-2009), and, with the exception of the Primorye Territory, are weaker compared to annual changes of the index in the pre-crisis period (2005-2007). In general, for the period of 2009-2013, all regions of the RF have undergone considerable structural

changes, essentially surpassing the changes observed in the border regions of China as well as those at the macro level. The noticeable transformation of economic systems in the provinces of Inner Mongolia and Heilongjiang was observed over the whole analyzed period of time (the values of the Salai and Gatev indices as well as Ryabtsev criterion are changed within the range from 0.14 to 0.27).

The employment of Herfindahl index (Table 4) to characterize the diversification of the regional economy has certain peculiarities: Its value depends on the degree of the source data detail. In this case, for all considered regions, the coefficient indicates a low concentration of foreign economic activity, that is, the economy structure in the regions with regard to considered groups is differentiated. Let disregard from the absolute value of the index and focus on its dynamics:

- In all cases, except of Trans-Baikal Territory, the economy of the border regions in 2004 was less diversified than in 2009;
- In some regions (Amur Region, Trans-Baikal Territory, Irkutsk Region, Jewish Autonomous Region) the economy has become less diversified in 2013 than in 2004;
- The economy of the border regions of China is less diversified than the economy of the RF;
- The economy of the border regions of China is less diversified relative to the economy level of whole country, while in the border regions of the RF (except for Irkutsk Region in 2012-2013) the situation is just opposite.

During the global financial crisis (2008-2009) there have been some hopes that it will trigger a significant transformation of

the existing economic systems in many countries. This period is even called “Time for opportunities” (Zabelina and Klevakina, 2010). The changes observed in the border regions of the RF are negligible, that is, neither the crisis nor the expansion of Russian and Chinese economic cooperation have had a significant impact on the noticeable concentration of activity in any industry.

5. CONCLUSION

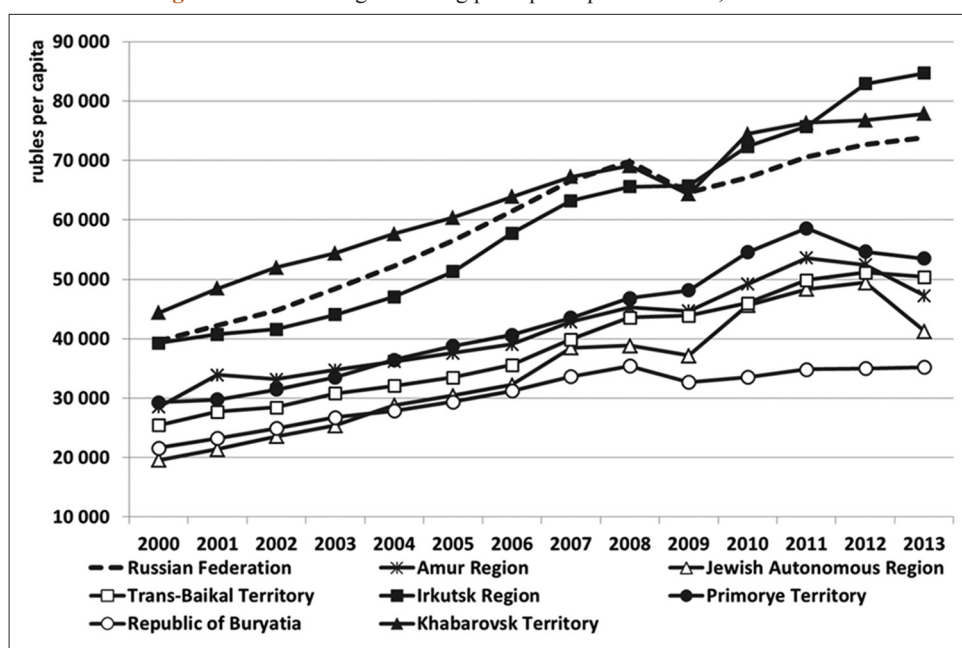
In the course of the study we carried out a quantitative assessment of structural changes in the economic systems of the border regions. It was revealed that the current long-term cross-border relations between regions of Russia and China have a certain influence on the ongoing structural changes occurring in the border regions, which is more noticeable in the less economically developed regions of the RF. In favor of this hypothesis is the fact that the annual changes in the border regions of the RF are significantly greater than the average for Russia. Turning to the GRP growth dynamics per capita in these regions (Figure 4), we note that its growth rate is generally at the level of the RF, while the absolute value of the index in most regions is below the national

Table 4: Herfindahl index

Region/Country	2004	2005	2006	2008	2009	2011	2012	2013
The Jewish Autonomous Region	0.18	0.17	0.19	0.2	0.18	0.2	0.18	0.19
The Amur Region	0.17	0.18	0.17	0.2	0.17	0.2	0.17	0.18
The Khabarovsk Territory	0.17	0.17	0.16	0.2	0.16	0.2	0.16	0.17
The Primorye Territory	0.16	0.17	0.17	0.2	0.15	0.2	0.15	0.16
The Irkutsk Region	0.20	0.21	0.21	0.2	0.18	0.2	0.21	0.21
Trans-Baikal Territory	0.18	0.17	0.18	0.2	0.19	0.2	0.18	0.19
The Republic of Buryatia	0.19	0.20	0.19	0.2	0.19	0.2	0.18	0.18
Russia	0.20	0.21	0.20	0.2	0.19	0.2	0.19	0.19
Heilongjiang	0.28	0.29	0.29	0.28	0.23	0.25	0.22	0.20
Inner Mongolia	0.19	0.21	0.23	0.28	0.26	0.28	0.28	0.27
China	0.23	0.23	0.24	0.23	0.22	0.22	0.21	0.20

Source: The authors' calculations

Figure 4: Growth of gross rating point per capita in Russia, 2000-2013



average. Thus, the authors conclude that the observed structural changes do not lead to a qualitative improvement of the sectorial structure of the economy in the border regions of the RF, able to improve greatly the quality of life for the people living there. The revealed tendency of increase in the proportion of the extractive sector in the economies of certain regions of Siberia and the Far East require special attention from public authorities, as growing resource orientation of the economy makes it more vulnerable to external shocks (compared to a diversified economy). In addition, a resource-based economy does not ensure the welfare of the population living in these areas, adequate to economic growth (Environmental Quality of Growth Indicators for Regional Economies, 2005).

Another important aspect is the negative impact of the extractive sector on the environment, as currently it produces the most significant proportion in the total volume of pollution. This promotes not only the accumulation of certain ingredients in natural environment (Tagaeva and Mkrtchyan, 2012) and deterioration in the quality of life of the population, but also causes damage to the economy due to the fact that the economy operates less efficiently in a polluted environment (Rjumina, 2009). Thus, the “positive” structural changes in the border regions will allow further economic development, reducing dependence on the mineral sector and thereby improving indirectly the indicators of sustainable development of ecological-economic system of the region. Therefore, it is important to take into account the qualitative parameters of structural changes along with the quantitative assessment. In the framework of the innovative economy development, China plans to transfer part of its production capacities to the territory of Russia. These include enterprises working in the field of metallurgy, chemical and cement industry. Experts indicate several reasons underlying this strategy. One reason is the greening of production in China, because the requirements for compliance with environmental regulations in China recently tightened. The Russian party has demonstrated certain interest (subject to compliance with existing environmental legislation) in transferring of production to sparsely populated regions of the Far East, expressing hope for economic development and reduction of population outflow in connection with the creation of new jobs. However, some statements of the Chinese party in the person of Deputy Chairman of China Mr. Li Yuanchao outspoken at the St. Petersburg International Economic Forum (June 2014) allow drawing conclusions that China is interested in employment of its own population as well. The transfer of manufacturing productions to the sources of raw materials will reduce production costs and definitely will mean a change in current ratios towards increasing the proportion of the extractive sector. Collectively, it may formally improve the structure of the economy, but will cause additional environmental load. Thus, the persons making strategic decisions need to understand how the projected structural changes will affect the balance between environmental and economic interests (Zabelina and Klevakina, 2012). In terms of possible expansion of cooperation within the economic zone of the Silk Road, structural changes on its own terms should not be the goal of regional policy in depressed regions, but should be considered only in the context of potential gains and losses in the welfare of the population.

The considered processes require changes to approaches in state regulation of cross-border relationships. Thus, in 2007-2008, the Russian economy has formed a certain potential for the development of remote territories of Baikal region and the Far East. The extension of state regulation in this area led to the establishment of a certain Ministry for Development of Russian Far East in the structure of state authority. Historically, the main type of state support of these areas was financial investment from the state reserves made through the major investment projects. The main guarantor of such state support was solely the scale of the planned event (for example, 10 million USD in the area of forest management). Global experience shows that in this case it is necessary to develop other criteria that do not depend on amount of investments. This will allow considering smaller projects, qualitatively improving the structure of the economy and reducing the specific load on the environment. For this purpose, for example, we could introduce into the managerial decision-making procedure the eco-intensity criterion (De Haan, 2004) which is a component the of cost-benefit analysis in environmental economics.

Deployment of manufacturing industries in Russia will lead to the expansion of the proportion of the secondary sector in the economy structure, though seeming prosperity in terms of implementation of infrastructural projects may hide serious consequences in the form of increased environmental load. In recent years, technological advancement in China has reached the level of advanced countries, and in some areas brought the country to the position of leadership – The most obvious example is wind power development. In this regard, special interest for Russia, when arranging processing facilities on its territory, is using the most advanced technologies, suitable modernization of equipment and application of advanced approaches to power supply of production. Thus, when making policy decisions, it is important to take into account not only the scope of the developed investment, but the environmental component, budget efficiency and technological aspects of the implementation of new businesses.

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