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Typology of the regions of the Russian Federation from the standpoint of developing a «green» economy with regard to the specifics of the economic space

Tipología de las Regiones de la Federación de Rusia desde el punto de vista del desarrollo de una economía «verde» con respecto a las características específicas del espacio económico

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Contents

ABSTRACT:
The model for estimating the "green" economy of the territory with the help of the tools of the IBM SPSS Statistics package was created in the article. A forecast is made for the development of the "green" economy of the UrFD subjects. A two-dimensional typology of the regions of the Russian Federation is proposed from the point of view of the development of the "green" economy. A portrait of typological groups of the parametric two-dimensional typology of Russian regions is described.

Keywords: «green» economy, typology, two-dimensional typology, statistical analysis

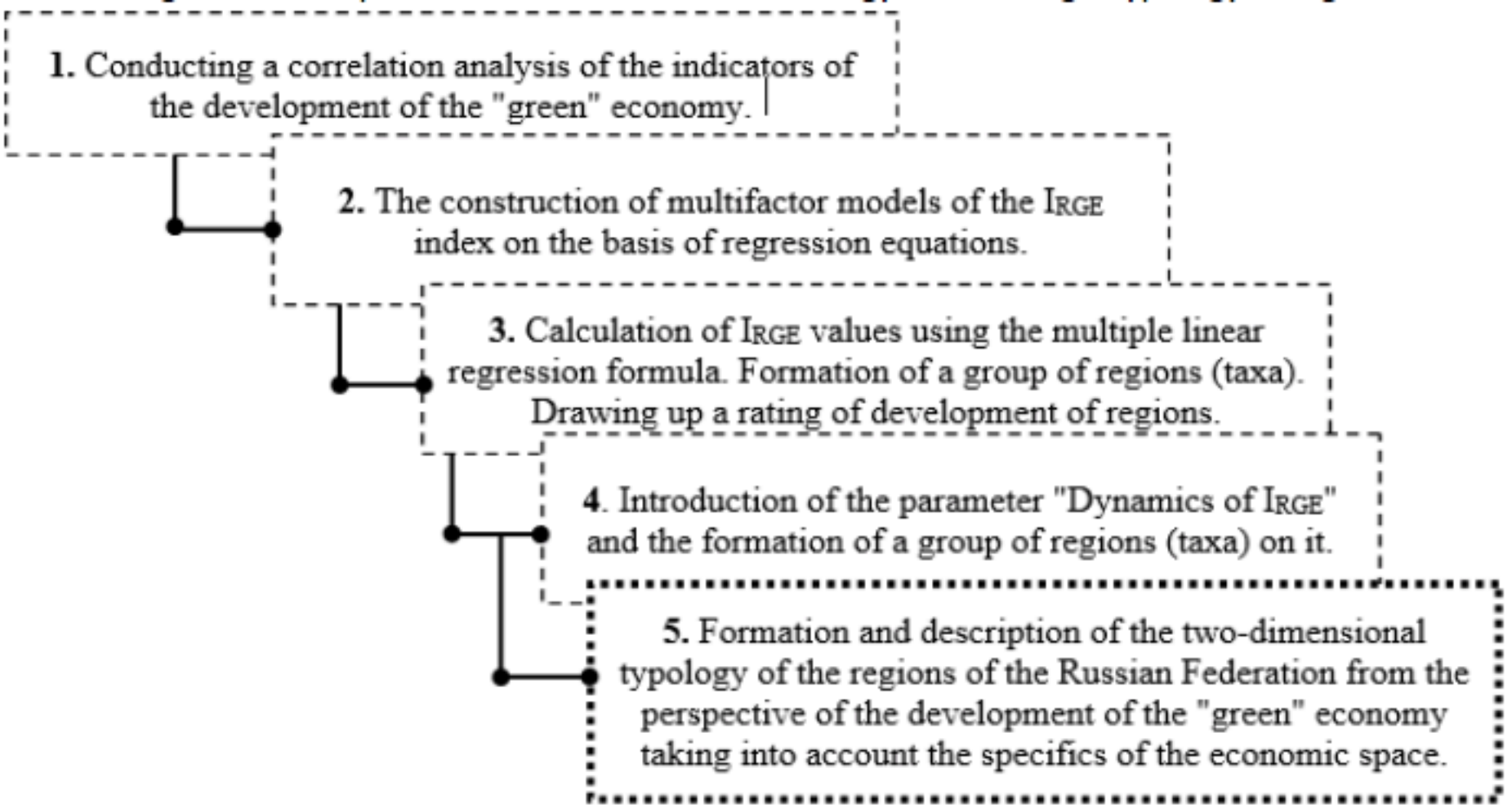
RESUMEN:
En el artículo se creó el modelo para estimar la economía "verde" del territorio con la ayuda de las herramientas del paquete IBM SPSS Statistics. Se realiza un pronóstico para el desarrollo de la economía "verde" de los sujetos de UrFD. Se propone una tipología bidimensional de las regiones de la Federación de Rusia desde el punto de vista del desarrollo de la economía "verde". Un retrato de los grupos tipológicos de la tipología paramétrica bidimensional de las regiones rusas.

Palabras clave: Economía «verde», tipología, tipología bidimensional, análisis estadístico

1. Introduction

The array of the studied information data made it possible to arrive at a logical representation of the content of the sequence of stages in developing the author's methodology for creating a typology of Russian regions from the position of developing a "green" economy taking into account the specific economic space (Figure 1).

Figure 1
Stages of development of the author's methodology for creating a typology of regions



Source: Prepared by the authors.

Earlier in the study, 60 indicators were proposed to assess the level of development of the “green” economy, taking into account the territorial space of the region (Gurieva & Simarova, 2016). Taking into account the main principles and approaches to the typology procedure (Korableva, 2016; Lavrik, 2002), it was decided to develop a two-dimensional typology of the regions of the Russian Federation from the position of developing a “green” economy taking into account the specifics of the economic space.

2. Discussion

At the first stage, a correlation analysis was conducted on selected groups of indicators: economic development, social well-being, environmental development, innovation development, investment development in order to identify the most significant.

The IBM SPSS Statistics 22 software package included statistical data in the 2010 - 2014 timeframe, which correlates with one of the main principles of indicative planning, namely comparability. For effective visualization, the indexes were assigned their serial numbers (for example, 1.1, 5.3, etc.), which corresponds to their conventions in the methodology for assessing the level of development of the “green” economy (Gurieva & Simarova, 2016).

The aim of the study was to identify the mutual influence of individual indicators on the resulting (integrated) within each block (investment, social, innovation, economic, environmental), while eliminating the most disconnected indicators that have minimal impact. The assessment is based on the following indicators of correlation analysis:

– Kendall's Tay-b rank correlation coefficient (introduced by the British statistician M. J. Kendell in 1938, shows the measure of the linear relationship between random variables);

– r-Spearman correlation coefficient (proposed by PE Spearman in 1904, this is a nonparametric method used to investigate the correlation relationship between phenomena);

– Pearson's correlation coefficient (developed in the nineties by the Group of Scientists, K. Pearson, F. Edgeworth and R. Weldon, shows the variability of the two variables).

When estimating the calculated values, the interpretation of the correlation coefficients was taken into account, with due regard to the level of its correlation (Table 1).

Table 1
Interpretation of the values of the correlation coefficient.

Value Range	Characteristics of connection
r > 0,01 ≤ 0,29	weak positive connection
r > 0,30 ≤ 0,69	moderate positive connection
r > 0,70 ≤ 1,00	strong positive connection
r > - 0,01 ≤ - 0,29	weak negative connection

r > -0,30 ≤ - 0,69	moderate negative connection
r > - 0,70 ≤ - 1,00	strong negative connection

Source: Prepared by the authors.

Using the IBM SPSS Statistics 22 software package and the Analysis-Correlation tool, the following results were obtained from the relationship between the individual group estimate indicators and the complex indicator (Table 2).

Table 2
The results of the correlation analysis of the system of indicators for assessing the development of the "green" economy in the economic space. The IBM SPSS Statistics package 22.

The block of indicators of economic development of the "green" economy														
			1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	1.11	1.12	The final
Kendall's Tau-b	1.1	Correlation coefficient	1,000	-,333	,429	-,048	.	,143	-,048	,143	,293	.	,619	.	,810*
		Significant (2-sided)	.	,293	,176	,881	.	,652	,881	,652	,362	.	,051	.	,011
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	The final	Correlation coefficient	,810*	-,143	,619	-,048	.	,333	-,238	-,048	,293	.	,429	.	1,000
		Significant (2-sided)	,011	,652	,051	,881	.	,293	,453	,881	,362	.	,176	.	.
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
Ro Spearman's	1.1	Correlation coefficient	1,000	-,464	,571	-,143	.	,179	,000	,214	,414	.	,821*	.	,893**
		Significant (2-sided)	.	,294	,180	,760	.	,702	1,000	,645	,355	.	,023	.	,007
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	The final	Correlation coefficient	,893**	-,179	,786*	-,071	.	,500	-,286	,036	,342	.	,643	.	1,000
		Significant (2-sided)	,007	,702	,036	,879	.	,253	,535	,939	,452	.	,119	.	.
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
1.1	Pearson's Correlation		1	-,224	,572	-,734	.a	,068	,139	,292	,456	.a	,689	.a	,834*
	Significant (2-sided)			,629	,179	,061	.	,885	,766	,525	,304	.	,087	.	,020
	The sum of squares and cross products		,023	-,005	,000	,000	,000	,000	,000	,002	,002	,000	,007	,000	,003
	Covariance		,004	-,001	,000	,000	,000	,000	,000	,000	,000	,000	,001	,000	,000
	N		7	7	7	7	7	7	7	7	7	7	7	7	7
	N		7	7	7	7	7	7	7	7	7	7	7	7	7
…	…		…	…	…	…	…	…	…	…	…	…	…	…	…
The final	Pearson's Correlation		,834*	,277	,817*	-,380	.a	,572	-,344	,174	,361	.a	,636	.a	1
	Significant (2-sided)		,020	,548	,025	,401	.	,180	,450	,709	,426	.	,125	.	
	The sum of squares and cross products		,003	,001	,000	,000	,000	,000	,000	,000	,000	,000	,001	,000	,000
	Covariance		,000	,000	,000	,000	,000	,000	,000	,000	,000	,000	,000	,000	,000
	N		7	7	7	7	7	7	7	7	7	7	7	7	7

Block of indicators of social well-being of the "green" economy														
			2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	2.12	The final
Kendall's Tau-b	2.1	Correlation coefficient	1,000	,714*	,810*	-,238	,390	-,714*	,714*	,810*	.	.	-,238	,714*	,429
		Significant (2-sided)	.	,024	,011	,453	,224	,024	,024	,011	.	.	,453	,024	,176
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	The final	Correlation coefficient	,429	,143	,238	,333	,586	-,143	,143	,429	.	.	-,238	,524	1,000
		Significant (2-sided)	,176	,652	,453	,293	,068	,652	,652	,176	.	.	,453	,099	.
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
Ro Spearman's	2.1	Correlation coefficient	1,000	,857*	,893**	-,286	,360	-,857*	,857*	,929**	.	.	-,536	,857*	,429
		Significant (2-sided)	.	,014	,007	,535	,427	,014	,014	,003	.	.	,215	,014	,337
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
	…	…	…	…											
	The final	Correlation coefficient	,429	,143	,321	,500	,757*	-,179	,179	,536	.	.	-,357	,679	1,000
		Significant (2-	,337	,760	,482	,253	,049	,702	,702	,215	.	.	,432	,094	.

		sided)													
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
2.1	Pearson's correlation		1	,489	,923**	-,158	,335	-,618	,651	,488	.b	.b	-,475	,549	,704
	Significant (2-sided)			,265	,003	,734	,463	,139	,113	,266	.	.	,282	,202	,078
	N		7	7	7	7	7	7	7	7	7	7	7	7	7
…	…		…	…	…	…	…	…	…	…	…	…	…	…	…
The final	Pearson's correlation		,704	,160	,556	,367	,680	-,227	,198	,270	.	.	,282	,202	,078
	Significant (2-sided)		,078	,732	,195	,418	,093	,624	,671	,559	7	7	7	7	7
	N		7	7	7	7	7	7	7	7	7	7	7	7	7

The block of indicators of ecological development of the "green" economy

			3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	The final
Kendall's Tau-b	3.1	Correlation coefficient	1,000	,619	.	.	,810*	,333	.	,551	1,000**	1,000**	,238	.	,810*
		Знач. (2-х сторонняя)	.	,051	.	.	,011	,293	.	,091	.	.	,453	.	,011
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	The final	Correlation coefficient	,810*	,810*	.	.	,810*	,524	.	,751*	,810*	,810*	,429	.	1,000
		Знач. (2-х сторонняя)	,011	,011	.	.	,011	,099	.	,021	,011	,011	,176	.	.
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
Ro Spearman's	3.1	Correlation coefficient	1,000	,643	.	.	,929**	,357	.	,709	1,000**	1,000**	,357	.	,893**
		Знач. (2-х сторонняя)	.	,119	.	.	,003	,432	.	,074	.	.	,432	.	,007
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	The final	Correlation coefficient	,893**	,893**	.	.	,893**	,607	.	,873*	,893**	,893**	,607	.	1,000
		Significant (2-sided)	,007	,007	.	.	,007	,148	.	,010	,007	,007	,148	.	.
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
3.1	Pearson's correlation		1	,621	.a	.a	,888**	,504	.a	,923**	,964**	,964**	,503	.a	,917**
	Significant (2-sided)			,137	.	.	,008	,249	.	,003	,000	,000	,250	.	,004
	N		7	7	7	7	7	7	7	7	7	7	7	7	7
…	…		…	…	…	…	…	…	…	…	…	…	…	…	…
The final	Pearson's correlation		,917**	,837*	.a	.a	,917**	,670	.a	,820*	,905**	,905**	,794*	.a	1
	Significant (2-sided)		,004	,019	.	.	,004	,100	.	,024	,005	,005	,033	.	
	N		7	7	7	7	7	7	7	7	7	7	7	7	7

Block of indicators for innovative development of the green economy

			4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11	4.12	The final
Kendall's Tau-b	4.1	Correlation coefficient	1,000	,048	,143	,714*	,048	,238	,238	,233	,000	,206	,048	,238	,143
		Significant (2-sided)	.	,881	,652	,024	,881	,453	,453	,497	1,000	,530	,881	,453	,652
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	The final	Correlation coefficient	,143	,333	,429	,238	,524	,333	,333	-,350	,178	,309	,905**	,333	1,000
		Significant (2-sided)	,652	,293	,176	,453	,099	,293	,293	,308	,617	,347	,004	,293	.
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
Ro Spearman's	4.1	Correlation coefficient	1,000	,071	,179	,857*	,143	,250	,250	,299	,000	,222	,036	,286	,143
		Significant (2-sided)	.	,879	,702	,014	,760	,589	,589	,515	1,000	,632	,939	,535	,760
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	The final	Correlation coefficient	,143	,571	,643	,286	,714	,607	,607	-,418	,204	,408	,964**	,393	1,000
		Significant (2-sided)	,760	,180	,119	,535	,071	,148	,148	,350	,661	,364	,000	,383	.
		N	7	7	7	7	7	7	7	7	7	7	7	7	7

4.1	Pearson's correlation	1	,124	,060	,890**	,704	,356	,156	,341	-,087	,477	,358	,750	,650
	Significant (2-sided)		,791	,899	,007	,078	,433	,739	,454	,853	,279	,430	,052	,114
	N	7	7	7	7	7	7	7	7	7	7	7	7	7
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
The final	Pearson's correlation	,650	,358	,356	,906**	,957**	,443	,265	-,042	-,041	,730	,925**	,809*	1
	Significant (2-sided)	,114	,431	,433	,005	,001	,319	,565	,929	,931	,063	,003	,027	
	N	7	7	7	7	7	7	7	7	7	7	7	7	7
The block of indicators of investment development of the "green" economy														
			5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	5.10	5.11	5.12	The final
Kendall's Tau-b	5.1	Correlation coefficient	1,000	.	-,048	,524	,238	.	,619	.	,683*	,524	1,000**	,429	,810*
		Significant (2-sided)	.	.	,881	,099	,453	.	,051	.	,033	,099	.	,176	,011
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
	…	…													
	The final	Correlation coefficient	,810*	.	,143	,524	,429	.	,810*	.	,683*	,714*	,810*	,619	1,000
		Significant (2-sided)	,011	.	,652	,099	,176	.	,011	.	,033	,024	,011	,051	.
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
Ro Spearman's	5.1	Correlation coefficient	1,000	.	,000	,679	,321	.	,786*	.	,847*	,679	1,000**	,643	,929**
		Significant (2-sided)	.	.	1,000	,094	,482	.	,036	.	,016	,094	.	,119	,003
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
	…	…													
	The final	Correlation coefficient	,929**	.	,214	,643	,536	.	,929**	.	,775*	,893**	,929**	,750	1,000
		Significant (2-sided)	,003	.	,645	,119	,215	.	,003	.	,041	,007	,003	,052	.
		N	7	7	7	7	7	7	7	7	7	7	7	7	7
5.1	Pearson's correlation		1	.a	-,454	-,024	,124	.a	,732	.a	,877**	,676	1,000**	,956**	,821*
	Significant (2-sided)			.	,307	,959	,791	.	,062	.	,010	,095	,000	,001	,023
	N		7	7	7	7	7	7	7	7	7	7	7	7	7
…	…		…	…	…	…	…	…	…	…	…	…	…	…	…
The final	Pearson's correlation		,821*	.a	,093	,412	,513	.a	,943**	.a	,857*	,937**	,821*	,750	1
	Significant (2-sided)		,023	.	,842	,358	,239	.	,001	.	,014	,002	,023	,052	
	N		7	7	7	7	7	7	7	7	7	7	7	7	7

**. Correlation is significant at the level of 0.05 (two-sided).*
***. Correlation is significant at the level of 0.01 (bilateral).*
a. Computation is impossible, because at least one of the variables is a constant.

Source: Prepared by the authors.

The correlation analysis allowed leaving 18 key indicators that exert maximum impact on complex indicators of the level of development of the "green" economy:

The gross profit of the economy and gross mixed incomes in the regions of the Russian Federation;

1.3 Indices of the physical volume of retail trade turnover;

2.5 Fertility rate;

3.1 Current (operational) costs of protecting the environment;

3.2 Expenditures for capital repairs of fixed assets for environmental protection;

3.5 Investments in fixed assets aimed at protecting the environment and rational use of natural resources;

3.8 Special costs associated with environmental innovation;

3.9 Information on payment for negative impact on the environment (environmental payments);

3.10 Emissions of pollutants into the atmospheric air;

4.4 The share of people engaged in research and development in the average annual number of employees in the economy of the region;

4.5 Specific weight of organizations that carried out technological innovations in the total number of organizations (by industrial production organizations);

4.11 Number of advanced manufacturing technologies developed in the region, per million people of economically active population;

4.12 Number of articles published in peer-reviewed journals indexed at RSCI, per 10 researchers;

5.1 Investments in fixed assets (without budget investments) per capita;

5.7 Direct investments into Russia from abroad;

5.9 The ratio of the volume of investments in fixed assets to the gross regional product;

5.10 The amount of attracted extra-budgetary funds;

5.11 The volume of investments in fixed assets, excluding budgetary funds, per 1 person.

It is noteworthy that the largest number of private indicators fell on the environmental block, which proves a direct relationship between the sustainability of development and the ecological well-being of the territory (Rudneva et al., 2016).

At the second stage, a survey of identified private indicators was conducted on the basis of constructing multifactor models of the green economy indicator in the IBM SPSS Statistics 22 software package and the Analysis-Regression-Linear tool with multiple variables, i.e. The method of excluding minor indicators from 18 previously selected was used. In this case, multiple linear regression will reflect the impact of the most significant private indicators of the "green" economy's assessment on the integral resultant index (Table 3, Figure 2). Calculations allow to optimize the evaluation procedure.

Table 3

Building a multiple regression model for assessing the level of the green economy of the territory (fragmented summary table) IBM SPSS Statistics software package 22 *

Descriptive statistics of specific indicators of the green economy			
	Average value	Standard deviation	N
TOTAL	,00223429	,003998270	7
1.1	,07430429	,062416723	7
1.3	,00224286	,001083754	7
2.5	,12454000	,058898086	7
3.1	,03545857	,036147530	7
3.2	,04190857	,035996464	7
3.5	,04537429	,036459649	7
3.8	,01289143	,020096953	7
3.9	,00981000	,009018049	7
3.10	,00951286	,008471351	7
4.4	,03530000	,023798459	7
4.5	,01010143	,005921454	7
4.11	,11511429	,090330715	7
4.12	,00347857	,001803390	7
5.1	,02149714	,028782837	7
5.7	,01857143	,024856028	7
5.9	,03925714	,037910370	7
5.10	,02241143	,026277749	7
5.11	,02687000	,035977754	7

Coefficients of the multiple regression model for assessing the level of the "green" economy of the territory					

Model		95,0% Confidence interval for B		Correlations			Collinearity statistics		Non-standardized coefficients		Standardized coefficients
		Bottom line	Upper bound	Zero order	Partially	Component	Tolerance	VIF	B	Standard Error	Beta
1	(Constant)	,008	,008						,008	,000	
	1.3	-2,313	-2,313	-,544	-1,000	-,562	,804	1,244	-2,313	,000	-,627
	3.2	-,058	-,058	-,493	-1,000	-,385	,544	1,839	-,058	,000	-,521
	3.5	-,067	-,067	-,527	-1,000	-,387	,399	2,506	-,067	,000	-,613
	3.8	,102	,102	-,230	1,000	,333	,417	2,396	,102	,000	,515
	4.12	1,234	1,234	,227	1,000	,480	,745	1,343	1,234	,000	,557
	5.11	-,025	-,025	-,316	-1,000	-,212	,877	1,140	-,025	,000	-,227

Correlations of the coefficients of the multiple regression model for assessing the level of the "green" economy of the territory

Model			5.11	4.12	1.3	3.2	3.8	3.5
1	Correlations	5.11	1,000	,167	-,104	,236	-,138	-,151
		4.12	,167	1,000	-,080	-,013	-,199	-,176
		1.3	-,104	-,080	1,000	,114	-,312	,006
		3.2	,236	-,013	,114	1,000	-,207	-,434
		3.8	-,138	-,199	-,312	-,207	1,000	-,439
		3.5	-,151	-,176	,006	-,434	-,439	1,000

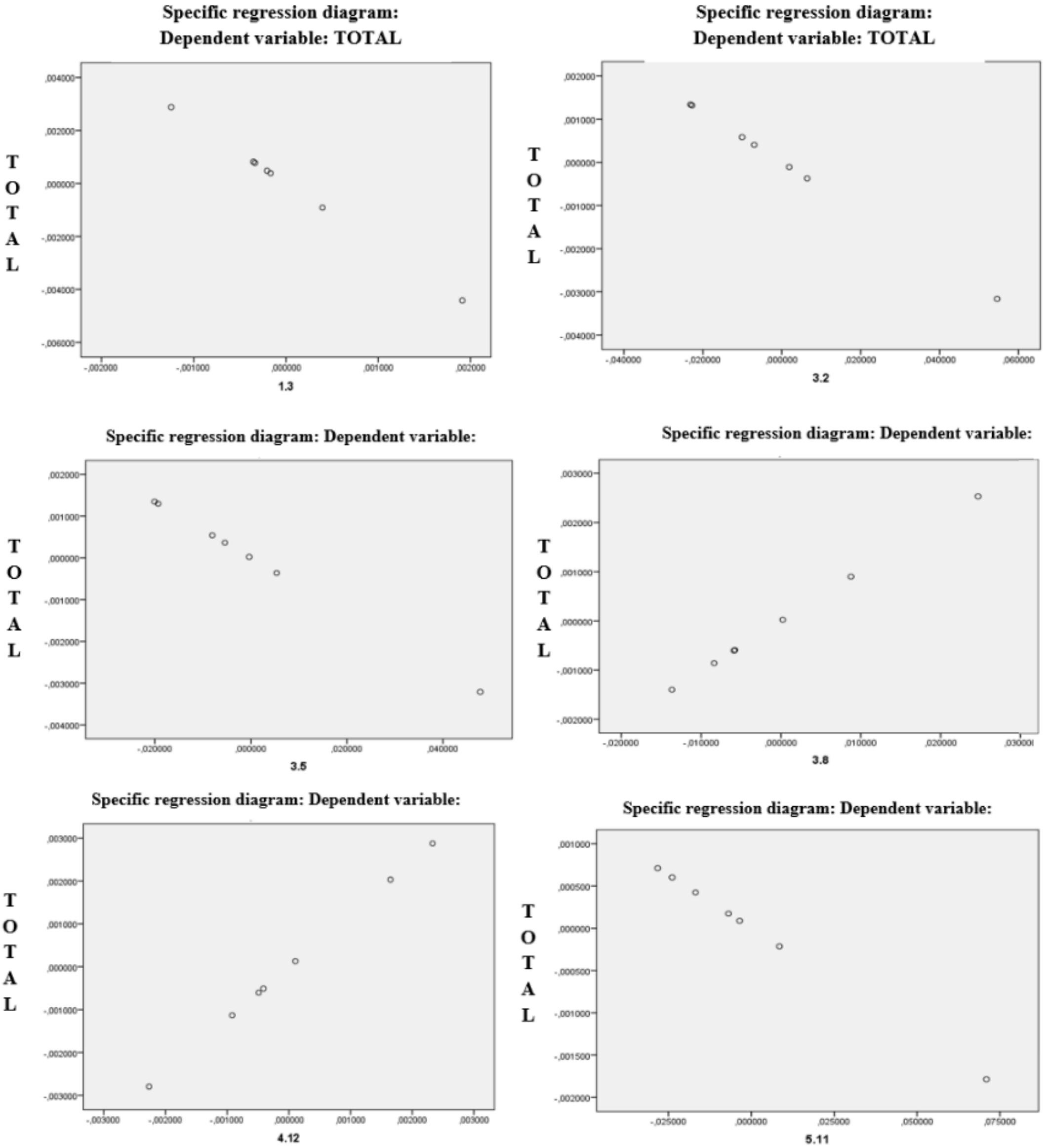
Diagnosis of the collinearity of the coefficients of the multiple regression model for assessing the level of the "green" economy of the territory

Model	Measurement	Eigenvalue	Conditionality index	Shares of variance						
				(Constant)	1.3	3.2	3.5	3.8	4.12	5.11
1	1	5,325	1,000	,00	,00	,01	,00	,01	,00	,01
	2	,670	2,819	,00	,00	,04	,01	,07	,00	,49
	3	,486	3,309	,03	,02	,00	,01	,25	,03	,23
	4	,230	4,814	,00	,11	,43	,03	,22	,03	,13
	5	,130	6,407	,00	,34	,19	,12	,02	,47	,01
	6	,105	7,118	,00	,06	,24	,83	,14	,20	,07
	7	,054	9,949	,96	,46	,10	,01	,31	,27	,05

* *dependent variable: TOTAL*
Source: Prepared by the authors.

The performed instrumental calculation procedures demonstrate the logicality of exclusion, for example, from the initial list of indicator 1.1 "Gross profit of the economy and gross mixed incomes by regions of the Russian Federation", as was previously mentioned in the study of a group of scientists led by S.N. Bobylev while drawing up the ecological and economic rating of Russian regions (Bobylev et al., 2013).

Figure 2
Dependence of the level of development of the "green" economy on the specific indicators of the evaluation system in the IBM SPSS Statistics package 22



Source: Prepared by the authors.

This relationship can be represented as the following equation (formula 1):

$$I_{RGE} = 1{,}234 * X_{4.12} + 0{,}102 * X_{3.8} - 2{,}313 * X_{1.3} - 0{,}058 * X_{3.2} - -0{,}067 * X_{3.5} - 0{,}025 * X_{5.11} + 0{,}008, \quad (1)$$

where IRGE is the integral index of the development of the "green" economy in the economic space of the region;

X 4.12 is the number of articles published in peer-reviewed journals, indexed at RSCI, per 10 researchers;

X 3.8 is special costs associated with environmental innovation;

X 1.3 is indices of the physical volume of retail trade turnover;

X 3.2 is expenses for capital repairs of the main funds for environmental protection;

X 3.5 is investment in fixed assets aimed at protecting the environment and rational use of natural resources;

X 5.11 is the volume of investments in fixed assets, excluding budgetary funds, per 1 person.

2.1. Calculations

At the third stage, the integral index of the development of the "green" economy in the economic space of the region (IRGE) was calculated according to the formula (IRGE) (Table 4, figure 3).

Table 4
Summary table of values of integral index of development of the "green" economy of the region by the multiple linear regression formula (IRGE) for UrFD subjects, 2010 - 2015*

UrFD subject	2010	2011	2012	2013	2014	2015
Kurgan region	0,00824	-0,00102	0,01171	0,02035	0,01397	0,00800
Sverdlovsk region	-0,00107	-0,00544	0,00391	0,00728	0,00074	-0,00444
Tyumen region	0,00317	-0,00464	0,00206	-0,00385	-0,00231	-0,01765
Khanty-Mansi Autonomous Area-Yugra	0,00950	0,00001	0,00815	0,00697	0,00507	-0,00930
The Yamalo-Nenets Autonomous Okrug	0,01543	-0,00366	0,00703	0,00927	0,00263	-0,00898
Tyumen Region (without autonomous okrugs)	-0,04528	0,00738	0,00109	-0,00723	-0,00624	-0,00276
Chelyabinsk region	-0,00050	-0,00714	0,00694	0,01099	0,00624	-0,01646

** Using the data from the official site of the "Unified Interagency Information and Statistical System (EMISS)"*

Figure 3
Dynamics of the integral index of the development of the "green" economy in the economic space of the region by the multiple linear regression formula (IRGE), 2010-2015

Source: Prepared by the authors.

According to the actual calculated IRGE values for UrFD subjects and types of phase states of the vector development of the green economy (Gurieva & Simarova, 2016), the regions were divided into 3 groups according to the values of the integral result index of the development of the "green" economy in the economic space (table 5).

Table 5
Groups of regions (taxa) by the value of the integral index of the development of the "green" economy in the economic space of the region according to the multiple linear regression formula

The name of a group of regions (taxa)	**Value (IRGE) using the multiple linear regression formula**	**Description according to the types of phase states of the vector development of the "green" economy**
"Green" Regions (leading regions)	[0,6;1]	The introduction of the concept of a "green" economy. Accelerated growth of the "green" directions in the development of the region. The closer to the value of 1, the more the situation is characterized by being close to absolute stability.
"Brown" Regions (regions with insufficiently high level of development)	[0,00001;0,59999]	Gradual weakening of economic development forces, poor perception of the concept of a "green" economy and the acquisition of positive dynamics of the development of a "green" economy with a shift in values to the right limit of values.
"Red" Regions (outsiders)	[-1;0]	Weak perception of the concept of a "green" economy. The phase of economic losses.

Source: Prepared by the authors.

On the basis of results of the IRGE integral index and the criteria for the division of regions (Table 4, 5), a rating of the regions of the Urals Federal District was compiled for the level of development of the "green" economy as of 2010, 2015 and 2017 (Table 6).

Table 6
Rating of subjects by the level of development of the "green" economy in the economic space of the Urals Federal District as of 2010, 2015 and 2017

Region	2010	2015	2017 (the initial system of assessment for 60 indicators)
	(by the multiple linear regression formula with 6 indicators)		
"Green" Regions	-	-	-
"Brown" Regions	1 place YaNAO	1 place Kurgan region	1 place Kurgan region
	2nd place KhMAO		2 place Sverdlovsk region
	3rd place Kurgan region		3rd place Tyumen region
	4 place Tyumen region		4 place KhMAO
			5 and 6 place YaNAO Tyumen Region without the autonomous okrug
			7 place Chelyabinsk region
"Red"	5 place	2nd place	-

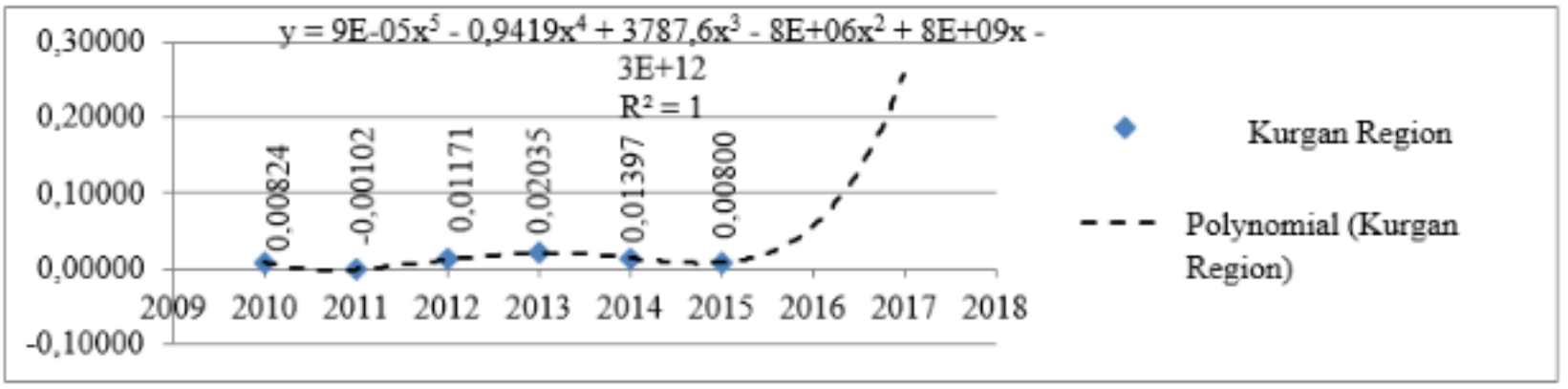
Regions	Chelyabinsk region	Tyumen Region without AO	
	6 place Sverdlovsk region	3rd place Sverdlovsk region	
	7 place Tyumen Region without autonomous okrug	4 and 5 place KhMAO YaNAO	
		6 place Chelyabinsk region	
		7 place Tyumen region	

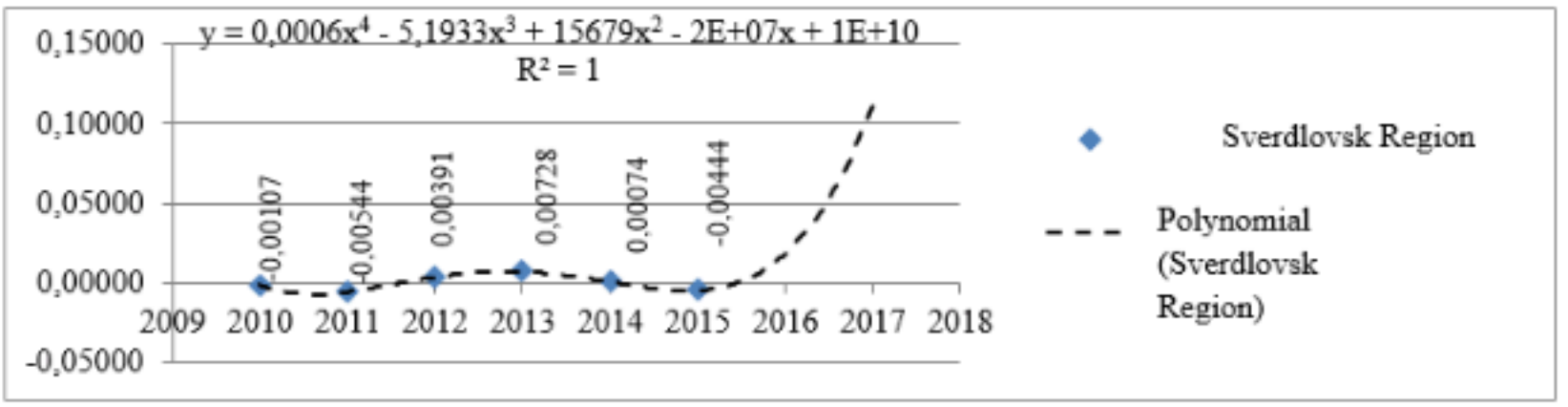
Source: Prepared by the authors.

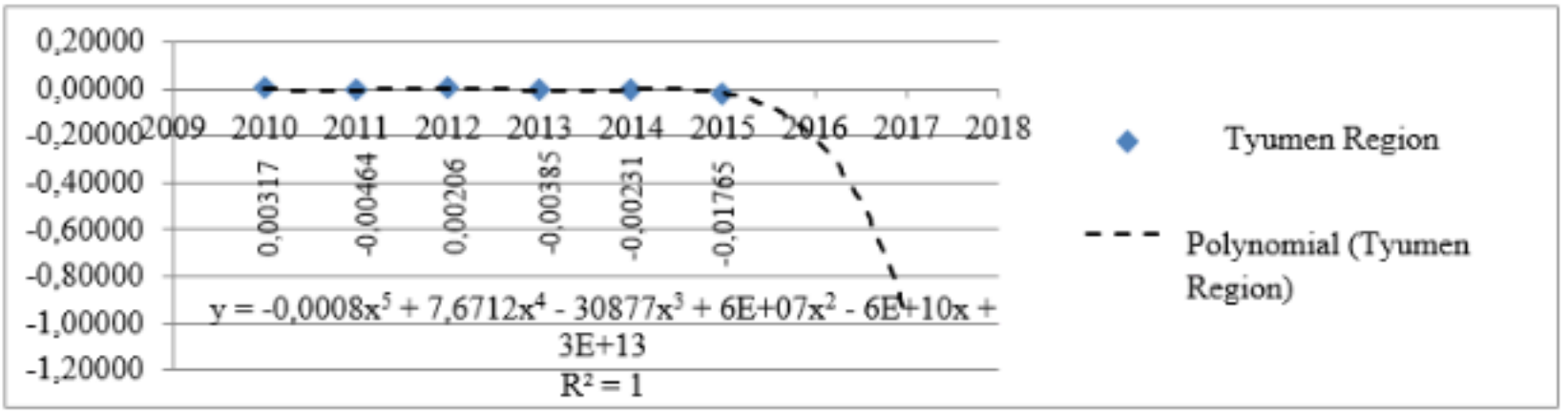
A high level of development of the “green” economy on the territory of the Urals Federal District is not observed in any entity, which may be related to the industrial specialization of the federal district. The leader in development is the Kurgan region. Table 5 compares the results obtained with the data obtained on the system for a full assessment of the level of development of the “green” economy (60 indicators) with a range of finite values from 0 to 1 inclusively. When comparing the final calculations, their logical interconnection is observed (Kolmakov et al., 2015).

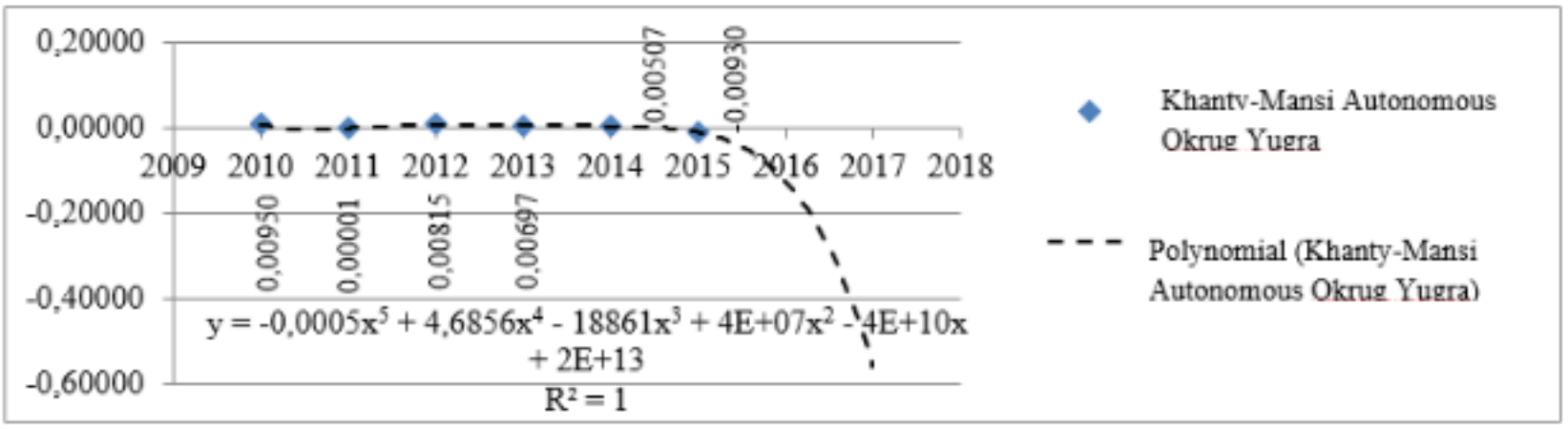
For effective application of the developed approach for assessing the level of development of the “green” economy of the territory of the regions, it is expedient to forecast possible options for changing the IRGE values based on the existing trend using mathematical modeling tools. In our study, an attempt was made to predict the values of the integral resultant index IRGE for 2016 - 2017, in the MS Excel software package, the Trend Line tool, and we consider it unreasonable to calculate further due to unpredictability of global factors (Figure 4).

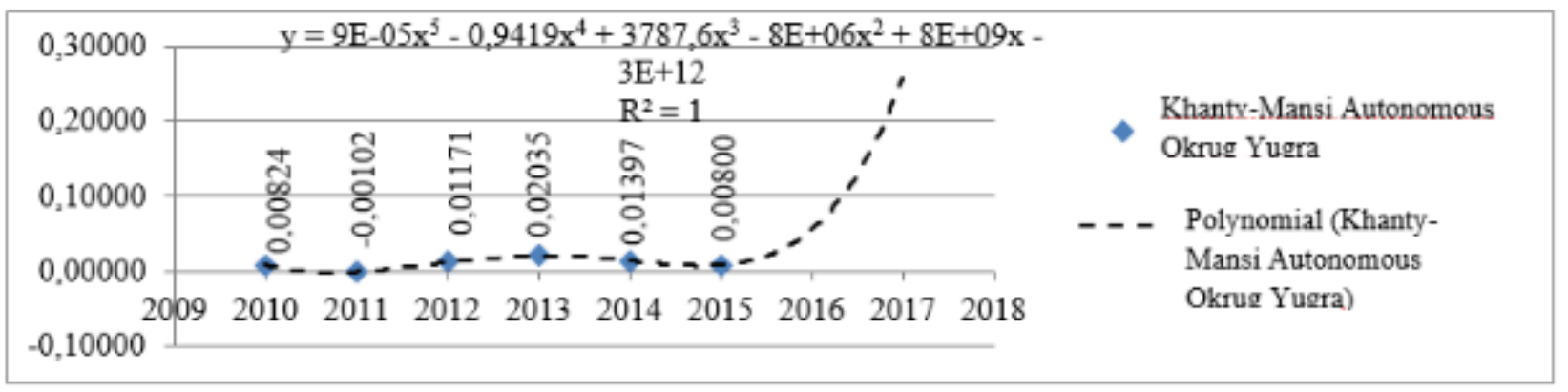
Figure 4
Forecast of the integral index of the development of the “green” economy in the economic space of the region using the multiple linear regression (IRGE) formula for 2016-2017

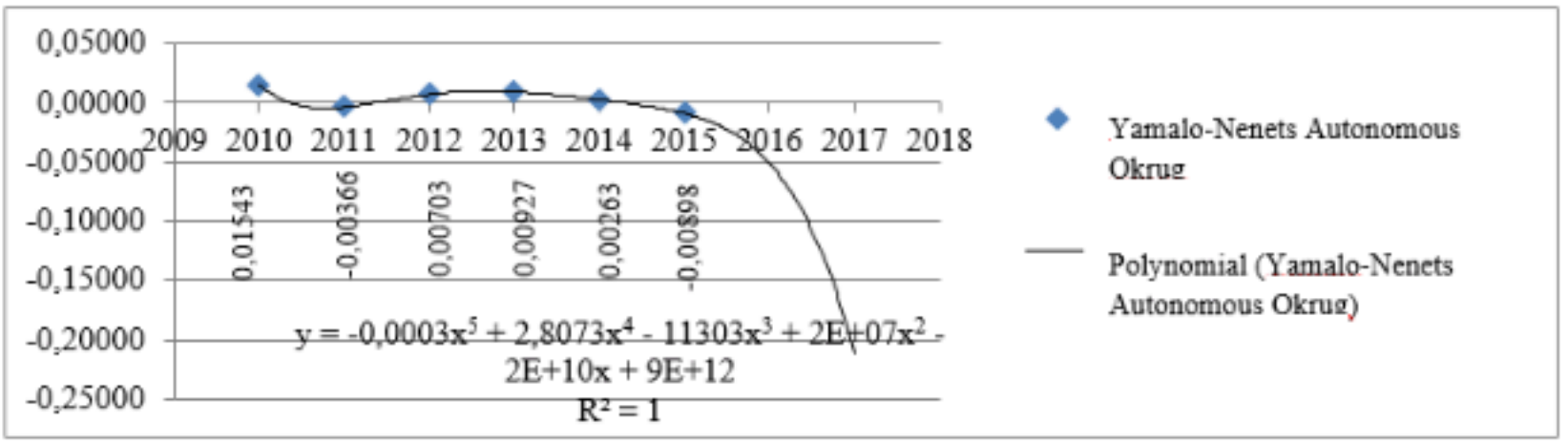

y = 9E-05x5 - 0,9419x4 + 3787,6x3 - 8E+06x2 + 8E+09x - 3E+12
R² = 1
0,30000
0,20000
0,10000
0,00000
-0,10000
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
0,00824
-0,00102
0,01171
0,02035
0,01397
0,00800
Kurgan Region
Polynomial (Kurgan Region)

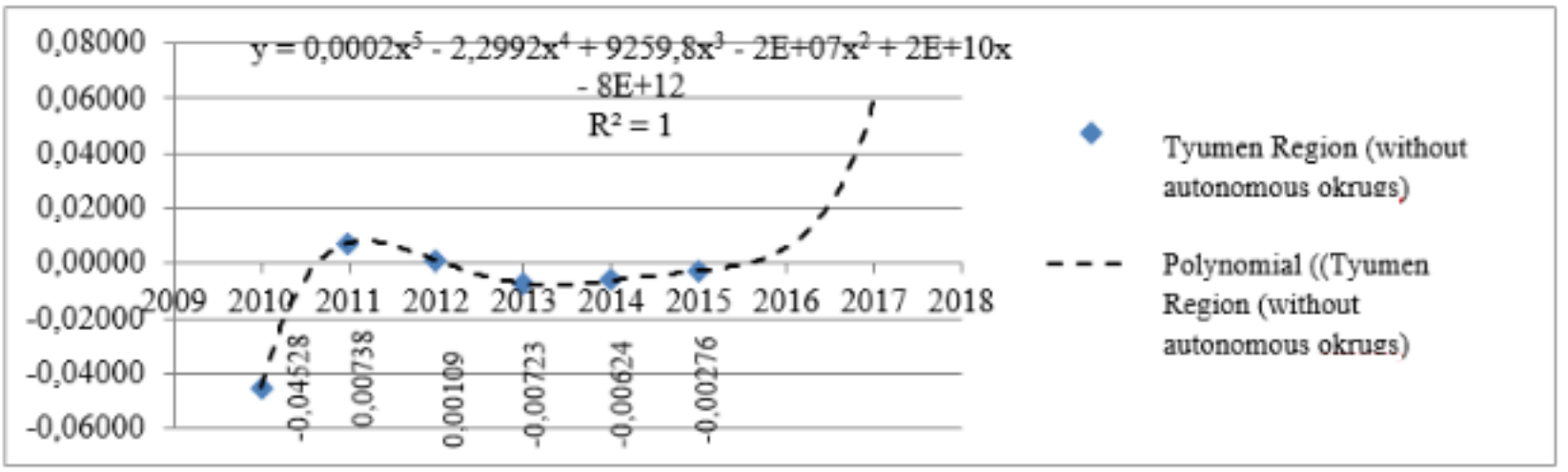

y = 0,0006x4 - 5,1933x3 + 15679x2 - 2E+07x + 1E+10
R² = 1
0,15000
0,10000
0,05000
0,00000
-0,05000
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
-0,00107
-0,00544
0,00391
0,00728
0,00074
-0,00444
Sverdlovsk Region
Polynomial (Sverdlovsk Region)

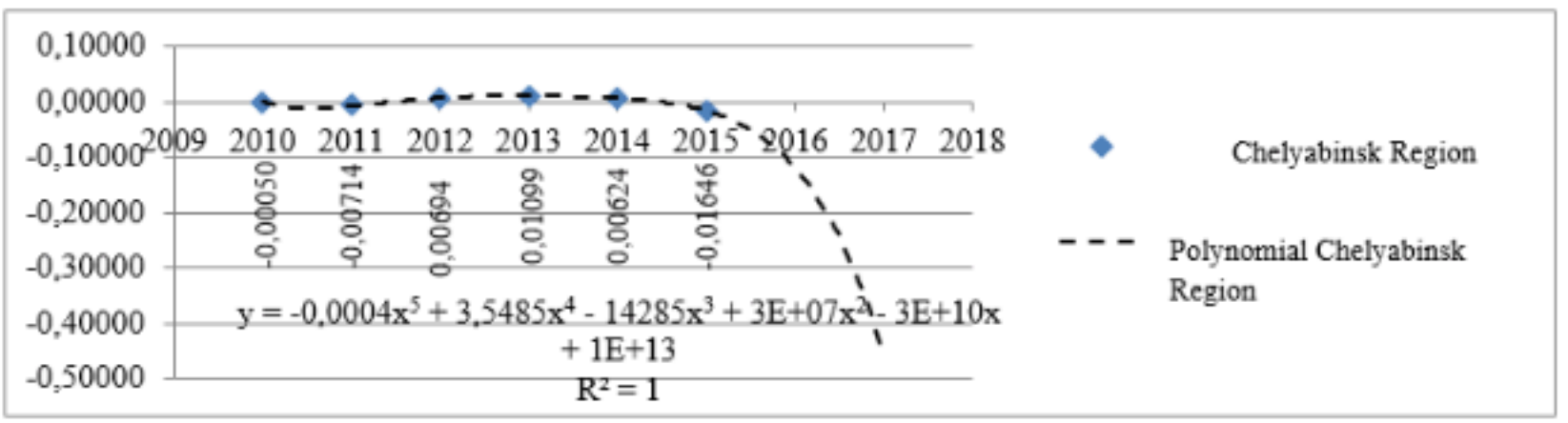

0,20000
0,00000
-0,20000
-0,40000
-0,60000
-0,80000
-1,00000
-1,20000
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
0,00317
-0,00464
0,00206
-0,00385
-0,00231
-0,01765
y = -0,0008x5 + 7,6712x4 - 30877x3 + 6E+07x2 - 6E+10x + 3E+13
R² = 1
Tyumen Region
Polynomial (Tyumen Region)


0,20000
0,00000
-0,20000
-0,40000
-0,60000
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
0,00950
0,00001
0,00815
0,00697
0,00507
-0,00930
y = -0,0005x5 + 4,6856x4 - 18861x3 + 4E+07x2 - 4E+10x + 2E+13
R² = 1
Khanty-Mansi Autonomous Okrug Yugra
Polynomial (Khanty-Mansi Autonomous Okrug Yugra)


y = 9E-05x5 - 0,9419x4 + 3787,6x3 - 8E+06x2 + 8E+09x - 3E+12
R² = 1
0,30000
0,20000
0,10000
0,00000
-0,10000
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
0,00824
-0,00102
0,01171
0,02035
0,01397
0,00800
Khanty-Mansi Autonomous Okrug Yugra
Polynomial (Khanty-Mansi Autonomous Okrug Yugra)


0,05000
0,00000
-0,05000
-0,10000
-0,15000
-0,20000
-0,25000
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
0,01543
-0,00366
0,00703
0,00927
0,00263
-0,00898
y = -0,0003x5 + 2,8073x4 - 11303x3 + 2E+07x2 - 2E+10x + 9E+12
R² = 1
Yamalo-Nenets Autonomous Okrug
Polynomial (Yamalo-Nenets Autonomous Okrug)





Source: Prepared by the authors.

The results obtained not only provide for rating of subjects by the level of development of the “green” economy in the economic space of the Urals Federal District, but also reflect the qualitative parameters of the state of the regions through quantitative estimates.

At the fourth stage of the study, it is proposed to introduce the grouping parameter of the subjects according to the dynamics of the development of the integral resultant index IRGE, represented through the calculation of the growth rates and their averaged value. This qualitative characteristic will allow displaying the general dynamics of the development of the “green” economy and sustainable development in the whole for the studied subject, which can also serve as a certain indicator of the effectiveness of the conducted regional policy (Table 7).

Table 7

Dynamics of the integral index of the development of the “green” economy in the economic space of the region by the multiple linear regression formula (IRGE), 2010-2015*

	Growth rate					**Increase rate**					**Average value**
UrFD subject	**2011**	**2012**	**2013**	**2014**	**2015**	**2011**	**2012**	**2013**	**2014**	**2015**	
Kurgan region	-0,12	-11,50	1,74	0,69	0,57	-1,12	-12,50	0,74	-0,31	-0,43	-2,73
Sverdlovsk region	5,08	-0,72	1,86	0,10	-5,98	4,08	-1,72	0,86	-0,90	-6,98	-0,93
Tyumen region	-1,46	-0,44	-1,87	0,60	7,63	-2,46	-1,44	-2,87	-0,40	6,63	-0,11
Khanty-Mansi Autonomous Okrug-Yugra	10,62	0,08	0,86	0,73	-1,84	9,62	-0,92	-0,14	-0,27	-2,84	1,09
The Yamalo-Nenets Autonomous Okrug	-0,24	-1,92	1,32	0,28	-3,41	-1,24	-2,92	0,32	-0,72	-4,41	-1,79
Tyumen Region (without autonomous okrugs)	-0,16	0,15	-6,63	0,86	0,44	-1,16	-0,85	-7,63	-0,14	-0,56	-2,07
Chelyabinsk	14,17	-0,97	1,58	0,57	-2,64	13,17	-1,97	0,58	-0,43	-3,64	1,54

region											

Source: Prepared by the authors.

The parameter “Dynamics of the change in the integral resultant index IRGE” suggests the separation of subjects of analysis into the following three groups:

1) “Green Leaders” taxon (high positive dynamics of IRGE with average growth rate in the range [+1,51; 3]);

2) Brown followers taxon (low positive and small negative dynamics of IRGE with average growth rate in the range [-0.6, +1.5]);

3) “Red-outsiders” taxon (high negative dynamics of IRGE with average growth rate in the range [- 0.61; -3]).

At the fifth stage, we form a two-dimensional typology of the regions of the Russian Federation from the position of developing a green with regard to the specifics of the economic space, based on the calculated parameters – “IRGE Dynamics” or “Average Growth Rate of the Integral Resultant IRGE Index” (characterizes the sustainability of development) and “Level of Development «Green» economy of the region” (the calculation is based on 6-factorial multiple linear regression, formula 1).

The portrait of the typological groups of the parametric two-dimensional typology of the regions of the Russian Federation from the standpoint of the development of the “green” economy with regard to the specifics of the economic space is presented in Table 8.

Table 8

Portrait of typological groups of the parametric two-dimensional typology of RF regions from the position of development of the “green” economy with regard to the specifics of the economic space

Name	A typological group portrait	Taxon	
		Dynamics IRGE	IRGE development Level
“Neanderthals”	The region faces certain difficulties in the effectiveness of established sustainable development programs, which, as a rule, have purely top-down character. Low level of ecological and economic literacy of the population is coupled with increased anthropogenic pressure on the environment. Economic factors and interests dominate in development, which provide low potential for the development of the green economy and do not increase sustainability.	“Red outsiders”	“Red” Regions
“Traditionalists”	There are certain prospects for the development of a “green” economy in the region, there is a gradual shift of the economic dominant to other spheres of society. There are effectively implemented programs for sustainable development, work to create “green” knowledge is in progress. There are positive changes in sustainable development.	“Brown followers”	“Red” Regions
“Wanderers”	A clearly expressed potential for the development of a “green” economy, which needs to be realized. This group of regions demonstrates that the high positive dynamics of development of sustainability does not ensure the growth of its level of development. At high rates of development, though, there is no awareness of the need for a transition to a new development paradigm.	“Green Leaders”	“Red” Regions
“Innovators”	The first prerequisites for understanding the concept of a “green” economy is typical, the level of ecological literacy of the population has significantly increased, the basic directives in the field of sustainable development are being implemented more effectively. The average degree of formation of a “green” economy with a negative dynamic of development of sustainability. The apparent weakening of the influence of classical economic development factors.	“Red outsiders”	“Brown” regions
	An equilibrium state has been reached between the		

"Followers"	ecological, social and economic development dominants. In the region, a concrete understanding of the prospects for the development of sustainability and a "green" economy was formed. Questions about its further development begin to be studied. Particular attention is paid to the "green" propaganda of a new way of development. The revealed tendency can be rather promising at imposing of a correct vector of development.	"Brown followers"	"Brown" regions
"Sprinters"	The high positive dynamics of the development of sustainability demonstrates that there has been a preponderance of economic factors, the level of the "green" economy has remained relatively low, i.e. from the equilibrium state the region took as a basis for development classical economic factors, the rate of "going greener" is decreasing.	"Green Leaders"	"Brown" regions
"Neoconservatives"	An effective legal resource in the field of sustainable development, a high degree of the formation of a "green" economy with negative dynamics of the development of sustainability, which can be characteristic for the transition state of the region to a new paradigm of development, when the socio-legal maturity of the "greened" society actively shapes the development strategy of the region.	"Red outsiders"	Green Regions
"Persecutors"	There is a sustainable development of the "green" economy, burdened by the prevalence of economic factors in development, which is expressed in the average speed of the dynamics of the development of sustainability. To enhance effective functioning, it is necessary to realize the latent potential of all elements of the regional system.	"Brown followers"	Green Regions
"Stars"	The reference state of development, close to absolute stability, which is as yet unattainable, but demonstrates the potential for future growth and reflects the basic meaning of the green economy and the sustainable development paradigm presented at the UNO's Sustainable Development Goals	"Green Leaders"	Green Regions

Source: Prepared by the authors.

Thus, a matrix of parametric two-dimensional typology of regions is formed, which, according to the logic of its structure, correlates with the phase states of the vector development of the "green" economy (Gurieva & Simarova, 2016) of the region's economic space (Figure 6).

Figure 6
Parametric two-dimensional typology of the UrFD regions from the position of development of the "green" economy with regard to the specifics of the economic space in 2010 and 2015

IRGEDynamics	**"Green Leaders"**	*[+1,51; 3]*	***"Wanderers"***	***"Sprinters"***	***"Stars"***
			Weak degree of formation of the "green" economy with a high positive dynamics of sustainability development.	*The average degree of formation of a "green" economy with a high positive dynamics of development of sustainability.*	*High degree of formation of the "green" economy with a high positive dynamics of the development of sustainability.*
			Vector [+1; -1] Strength 0	**Vector [+1; 0] Strength +1**	**Vector [+1; +1] Strength +2**
			Significant influence of classical economic factors of	Significant influence of classical economic development factors, the	Accelerated growth of the "green" directions in the development of the region. The state is

			development, poor perception of the concept of "green" economy.	introduction of the concept of a "green" economy.	close to absolute stability.
	"Brown followers"	*[-0,6;+1,5]*	***"Traditionalists"*** *Weak degree of formation of the "green" economy with an average dynamics of the development of sustainability.* **The vector [0; -1] Strength -1** Gradual weakening of economic development forces, poor perception of the concept of a "green" economy.	***"Followers"*** *The average degree of formation of the "green" economy with the average dynamics of development of sustainability.* **Vector [0; 0] Strength 0** Average influence of classical economic factors of development. The equilibrium state of forces.	***"Persecutors"*** *The average degree of formation of the "green" economy with the average dynamics of development of sustainability.* **Vector [0 + 1] Strength +1** Average influence of classical economic factors of development. Sustainable development of the "green" economy
	"Red outsiders"	*[-0,61;-3]*	***"Neanderthals"*** *Weak degree of the formation of a "green" economy with a negative dynamics of development of sustainability.* **Vector [-1; -1] Strength -2** Weak influence of classical economic factors of development, poor perception of the concept of "green" economy. The phase of economic losses.	***"Innovators"*** *The average degree of formation of a "green" economy with a negative dynamics of development of sustainability.* **Vector [-1; 0] Strength -1** Weak influence of classical economic factors of development, the beginning of perception of the concept of "green" economy.	***"Neoconservatives"*** *High degree of formation of the "green" economy with negative dynamics of development of sustainability.* **Vector [-1; +1] Strength 0** Average influence of classical economic factors of development. Sustainable development of the green economy.
			"Red" Regions	**"Brown" regions**	**"Green" Regions**
			[-1;0]	*[0,00001;0,59999]*	*[0,6;1]*
			The level of development of the region's "green" economy (IRGE)		

Figure 6 - cont.
Parametric two-dimensional typology of the regions of the Russian Federation from the position of developing a "green" economy with regard to the specifics of the economic space (compiled by the author)

"Green	*[+1,51;*	***"Wanderers"***	***"Sprinters"***	***"Stars"***

Leaders”	*3]*	Chelyabinsk Region (2010)	**Chelyabinsk Region (2015)**	
“Brown followers”	*[-0,6;+1,5]*	***“Traditionalists”*** – The Tyumen Region (2010) **The Tyumen Region (2015)** **KhMAO (2015)**	***“Followers”*** – KhMAO (2010)	***“Persecutors”***
“Red outsiders”	*[-0,61;-3]*	***“Neanderthals”*** – The Sverdlovsk Region (2010) Tyumen Region without JSC (2010) **Tyumen Region without AO (2015)** **Sverdlovsk Region (2015) YaNAO (2015)**	***“Innovators”*** – Kurgan Region (2010) YaNAO (2010) **Kurgan Region (2015)**	***“Neoconservatives”***
		“Red” Regions	**“Brown” regions**	**“Green” Regions**
		[-1;0]	*[0,00001;0,59999]*	*[0,6;1]*
		The level of development of the region’s “green” economy (IRGE)		

Source: Prepared by the authors.

The results of the study show (Figure 6-cont) that a high level of development of the green economy does not provide for positive dynamic changes in the field of sustainability - the Kurgan Region (2010, 2015) and the Yamal Peninsula (2010). Despite the weak level of IRGE development, the Chelyabinsk region has a certain potential (2010, 2015), which is confirmed by the positive dynamics of the changes. Particular attention should be paid to the development program of the Sverdlovsk region, the Tyumen region without AO and KhMAO, where, with an average degree of formation of the “green” economy, there has been a negative dynamics of development of sustainability for 5 years. It should be noted that none of the investigated subjects of the Urals Federal District has a sufficiently high level of development of the “green” economy, which requires revision of the regional development programs, in order to accelerate interaction between the main elements of the “green” economy and sustainable development, which will contribute to the improvement and development of economic sustainability of the regions.

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3. Conclusions

The results obtained make it possible to formulate three regularities:

1) High level of development of the “green” economy does not ensure high positive dynamic changes in the field of sustainability; it is necessary to intensify the interaction of elements of the “green” economy within the region;

2) High positive dynamics of sustainability of development (“green” economy) is possible at its low level - the identified potential of the regions should be implemented;

3) High negative dynamics of IRGE is a negative indicator at any level of development of the “green” economy, which indicates that the sustainable development programs of the region are not sufficiently developed, which leads to a weakening of its competitive advantages and a loss of investment attractiveness.

The parametric two-dimensional typology of the Urals Federal District regions shows the need for a deeper analysis with the aim of studying the constraining factors of the development of the green economy and sustainable development of the regions, identifying bottlenecks and driving growth points that can be used in the government management of sustainable development of regions. Of particular importance is the prospective

study of the entire set of subjects of the Russian Federation on the basis of the typological grouping of the regions-entities based on the established in the study, from the position of developing a “green” economy and with due regard to the specifics of the economic space with the view of carrying out the clustering procedure.

Acknowledgement

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Bibliographic references

Bobylev, S.N., Minakov, V.S., Solovyova, S.V. & Tretyakov, V.V. *Ecological and Economic Index of Russian Regions, 2013*. Retrieved 21 August 2017 from URL: https://new.wwf.ru/upload/iblock/dc8/index.pdf.

Gurieva, M.A. & Simarova, I.S. (2016). Development of a model for the development of a “green” economy in the economic space. *Science and business: ways of development, 5*, 86-98.

Kolmakov, V.V., Polyakova, A. G. & Shalaev, V. S. (2015). An analysis of the impact of venture capital investment on economic growth and innovation: Evidence from the USA and Russia. *Economic Annals, 60*(207), 7-37.

Korableva, A.A. (2016). Interregional comparisons in the context of economic security. *Regional economy, 10*(144), 18-27.

Lavrik, D.A. (2002). *Typologization of regions as a basis for the formation of priorities for regional development:* PhD thesis. Ufa.

Rudneva, L.N., Pchelintseva I. G. & Gureva M.A. (2016). The Indicative System of Assessing the Level of Ecologization in the Context of the Region’s Sustainable Development. *International Journal of Economics and Financial Issues, 6*(S1), 227-232.

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[Índice]

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