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Environmental and Economic Disparity and the Porter Hypothesis in the Subjects of the Russian Federation

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Abstract. The article investigates the presence of ecological and economic disparity from the point of view of the Porter M. hypothesis. It complements the research that the costs of complying with environmental standards lead to an increase in economic efficiency, based on data from Russian regions. The methodology is based on a model for assessing the impact of environmental regulation on the productivity index. Environmental regulation refers to the cost of pollution control PACE, adjusted according to statistical data. The productivity index includes the dynamics of GDP, carbon dioxide emissions, labor force, capital investment and energy consumption. As a result, a direct relationship was found between the environmental regulation index and the productivity index. This proves the absence of ecological and economic disparity, that is, the costs of environmental protection do not reduce economic efficiency. The presented analysis methodology can be applied both at the macro level (of the region) and at the micro level of companies (including when evaluating the ESG strategy and environmental innovations).

Keywords: environmental-economic index, ESG, M. Porter's hypothesis, productivity, pollution control costs, environmental regulation.

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Research area: Social Structure, Social Institutions and Processes; Economics.

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Эколого-экономический диспаритет и гипотеза М. Портера в субъектах Российской Федерации

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Аннотация. В статье проводится исследование наличия эколого-экономического диспаритета с точки зрения гипотезы Портера М. Она дополняет исследования о том, что затраты на соблюдение экологических норм приводят к повышению экономической эффективности, на основе данных российских регионов. Методология построена на модели оценки влияния экологического регулирования на индекс производительности. Под экологическим регулированием понимаются расходы на борьбу с загрязнением PACE, адаптированным с учетом данных статистики. Индекс производительности включает динамику ВВП, выбросов углекислого газа, численности рабочей силы, капитальных вложений и потребленной энергии. В результате установлено наличие прямой связи между индексом экологического регулирования и индексом производительности. Это доказывает отсутствие эколого-экономического диспаритета, то есть затраты на охрану окружающей среды не снижают экономическую эффективность. Представленная методика анализа может быть применена как на макроуровне (региона), так и на микроуровне компаний (в том числе при оценке ESG-стратегии и экологических инноваций).

Ключевые слова: эколого-экономический индекс, ESG, гипотеза М. Портера, производительность, расходы на борьбу с загрязнением, экологическое регулирование.

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Introduction

The purpose of the study is to prove the presence or absence of ecological and economic disparity in the constituent entities of the Russian Federation in terms of the hypothesis of M. Porter. The essence of ecological and economic disparity: the use of resources for the growth of economic indicators leads to environmental degradation. If we consider the ecological and economic disparity at the micro

level, then it manifests itself in the following: investing in the environment reduces the efficiency of enterprises, as it requires additional costs. As a result, company management should make managerial decisions, making a choice between rapid economic growth or delayed long-term growth based on eco-innovations (Albrizio et al., 2017). The presence of contradictions between the achievement of high values of environmental or economic indicators leads to the emergence of disparity. However, the existence of M. Porter's hypothesis about increasing production efficiency by improving the environment, as well as separate studies devoted to proving it in foreign countries, determined the purpose of this study. The hypothesis of the study is based on the fact that at present, despite the relevance of the ESG agenda, many companies prefer to make decisions based on the certainty of the presence of environmental and economic disparity, making a choice in favor of the economy or in favor of the environment, but with the acceptance of economic damage (losses). Ecological and economic disparity lies in the inequality in the choice of priority for the development of companies between economic and environmental indicators. Overcoming and challenging this inequality by proving M. Porter's hypothesis based on the statistical data of Russian companies will increase the importance of argumentation when introducing eco-innovations in organizations, not only due to the fact that they have (should have) social responsibility, but also to understand the absence of economic losses from their implementation.

Literature review

At the present stage of development of the world economy in the field of achieving sustainable development goals, it is necessary to develop a "green" economy. According to the OECD, "Green growth means stimulating economic growth and development while ensuring that natural assets are preserved and continue to provide the resources and ecosystem services on which our well-being depends. To do this, it must catalyze investment and innovation that will underpin sustainable growth and lead to new economic opportunities" (OECD, 2011). To implement it, governments can apply both economic and administrative measures. In this case, their combination gives the best effect. However, until now, the subject of debate on the world stage is the question of the relationship between the economic growth of companies and the environmental standards established for them at the legislative level. At the same time, there is a hypothesis by M. Porter (Porter and van der Linde, 1995), which speaks of a direct relationship, that is, established environmental standards stimulate companies to carry out innovative activities, which as a result will increase productivity and compensate for the costs of environmental protection. This will ultimately increase the profitability of organizations.

This issue is given considerable attention in the works devoted to environmental management in China. In the work of Yusen Luo et al. (2022) M. Porter's hypothesis was confirmed based on macro indicators in China. As a result of modeling, it is proved that environmental regulation directly contributes to productivity growth, stimulates diversification and rational distribution of production. This effect is achieved through the development and implementation of "green" and industrial technological innovations in China.

In Wenjian He et al. (2022), through empirical research based on China's data, it was proved that in order to implement the M. Porter's hypothesis, it is necessary to conduct an anti-corruption campaign, as well as create innovative incentives for enterprises in order to improve their financial performance despite the increase in environmental standards. According to OECD countries, Yun Wang et al. (2019) that policies to manage environmental regulations are effective in terms of stimulating innovation and implementing the Porter hypothesis at a certain level of rigidity (beyond this, the positive effect is leveled). An interesting empirical study by Yiu Por (Vincent) Chen et al. (2022) in relation to small and medium enterprises in China, confirming the positive impact of environmental regulation on firms' investment in environmental protection and the power of ESG factors on the profitability of organizations. A study by Huan Zheng et al. (2023) provided new evidence for

the existence of Porter's hypothesis in China: the short-term negative and long-term positive impact of environmental regulations on firm performance.

In Russian studies, the confirmation of this hypothesis is not given due attention. This issue is indirectly addressed in the work of Burmatova O. P. (2018), based on a comparison of the costs of environmentally oriented innovations in the United States and the costs of compliance with environmental legislation. The lack of studies on the M. Porter hypothesis, using Russian data as an example, and the prospects for applying the results obtained in the development of a policy for managing environmental and economic disparity at the micro and macro levels determined the need and relevance of this study.

The study of the works of Chinese researchers, as well as Russian scientific works in the field of studying environmental indices and their relationship with the economy and social factors, served as the basis for developing a methodology for studying the environmental and economic disparity in the constituent entities of the Russian Federation in terms of proving the hypothesis of M. Porter.

Methodology

To determine the environmental and economic disparity in the subjects of the Russian Federation in terms of the hypothesis of M. Porter, it is proposed to build a model for assessing the impact of environmental regulation (independent variable) on the productivity index (dependent variable).

To measure the variable "environmental regulation", it is proposed to use the values of current costs and capital investments aimed at protecting the environment and rational use of natural resources, in international practice – the cost of pollution control PACE (Rubashkina et al., 2014).

To measure the productivity index, indicators are used: the number of employees, investment in fixed assets, energy consumption, GRP, CO_2 emissions. To measure dynamics, the formula for calculating the productivity index is as follows (based on Yusen Luo et al. (2022), Luo et al. (2022), Luo et al. (2020):

$$I_{prod} = \frac{\Delta GRP - \Delta CO_2}{\Delta Work + \Delta investments + \Delta Energy},$$

$$\Delta GRP = \frac{GRP_n - GRP_{n-1}}{GRP_{n-1}},$$

$$\Delta CO_2 = \frac{CO_{2_n} - CO_{2_{n-1}}}{CO_{2_{n-1}}},$$

$$\Delta Work = \frac{Work_n - Work_{n-1}}{Work_{n-1}},$$

$$\Delta investments =$$

$$= \frac{investments_n - investments_{n-1}}{investments_{n-1}},$$

$$\Delta Energy = \frac{Energy_n - Energy_{n-1}}{Energy_{n-1}},$$

n = 1,2,…, N – years of observations.

When calculating the productivity index, the dynamics of the number of employees, the volume of capital investments and the consumption of fuel and energy resources are assessed at the input; at the output, the positive effect is the growth of GRP, and the undesirable effect is the growth of carbon dioxide emissions. To eliminate the impact of inflation on security-related costs and GRP, the data are adjusted for the value of the core consumer price index. The theoretical framework of the study is shown in Fig. 1. When determining the dynamics of the productivity index, it is of great importance to determine the dynamics of the factors that influenced it, and therefore the analysis uses the decomposition of the index into input factors and resulting output.

To interpret the relationship after the calculation of the indices, a comparison is made: the dynamics of the indices in the region in similar periods; the direction of the trend lines built according to the indices.

Statistical collections and data from the Unified Interdepartmental Information Statistical System (EMISS) were used to form the database. The analysis was carried out for the period 2005–2021, the growth indices were determined, respectively, for 2006–2021 compared to the previous one (chain method). The names of the indicators used in Russian statistics and used to calculate the environmental

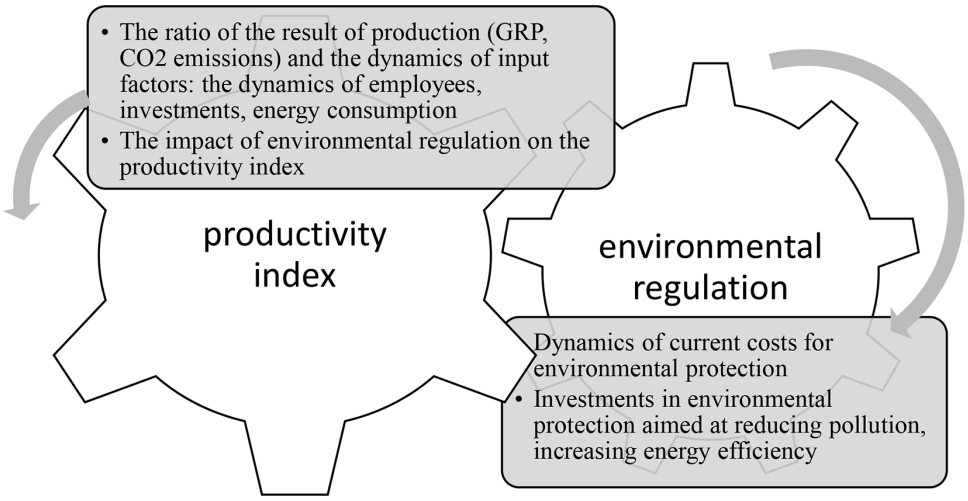

Fig. 1. Theoretical framework for the study of environmental and economic disparity in the constituent entities of the Russian Federation in terms of the hypothesis of M. Porter (compiled by the authors)

Table 1. Statistical data for the calculation of the productivity index and environmental regulation

Variable name	The name of the indicator in statistics
GRP	Gross regional product in basic prices (OKVED 2)
Work	The average number of employees for the full range of organizations
investments	Investments in fixed assets for a full range of organizations
Energy consumption	Fuel and energy resources consumed
CO_2 emissions	Pollutants released into the atmosphere from stationary sources
Current environmental costs	Current (operational) costs for environmental protection
Investments in environmental protection	Investments in fixed assets aimed at protecting the environment and rational use of natural resources

Compiled by the authors.

regulation index and the productivity index are presented in Table 1.

The selection of regions was carried out by regions with different structures of production diversification, specialization, migration processes, as well as by different climatic conditions. The sample included 6 regions of Russia: Novosibirsk Region, Tomsk Region, Republic of Bashkortostan, Khabarovsk Territory, Belgorod Region, Republic of Tatarstan, for comparison with the average Russian level, data for the Russian Federation as a whole were also calculated. A brief description of the regions is presented in Table 2. Note that the comparative characteristic confirms the different specifics, conditions and availability of resources.

Results

For the convenience of analyzing trends and dynamics, graphs are presented in Fig. 2, it uses two scales: on the left for the productivity index, on the right for the environmental regulation index.

We note large jumps in the indices in all regions (that is, there is no stable growth or decrease in the indices, the dynamics is uneven). The overlay of the trend line for indices allows you to assess the downward or upward movement of the indices as a whole for the period 2006–2021.

Table 2. Comparative characteristics of the regions of the study sample for 2017–2020

Sign	Novosibirsk region	Tomsk region	Republic of Bashkortostan	Khabarovsk region	Belgorod region	Republic of Tatarstan
Population migration	Population influx	Population influx	Population outflow	Population outflow	Population influx	Population influx
GRP per capita	400–440 million rubles	465–490 million rubles	350–370 million rubles	510–535 million rubles	520–565 million rubles	540–570 million rubles
Return on assets of organizations in the region	6–10 %	5–6 %	8–11 %	1–3 %	10–15 %	8–10 %
Regional cluster (specification)	Developed scientific research sector	High-tech industrial cluster	Fuel and energy, metallurgical, machine-building complexes	Defense industrial complex	Agro-industrial and mining and metallurgical complexes	Hydrocarbon sector
The level of economic diversification	Sufficient	Medium	Medium	High	High	Low
Place in the environmental ranking	69	41	46	74	2	44
Quality of life rating	23	50	26	29	6	4

Compiled by the authors.

When constructing a trend line for the productivity index and the environmental regulation index, it was revealed that there are unidirectional trends:

– growth of two indices of the Tomsk region, the upward trend of environmental regulation is more intense (from 0 to 1) than the trend of the productivity index (from –1 to 0);

– decrease in two indices: in the Belgorod region (the trend of the productivity index to decrease is more (from 1.2 to –0.2) than the index of environmental regulation – from 0.5 to 0.4), Khabarovsk Territory (the trend of the decrease in the productivity index is higher (from 3 to –1) than the index of environmental regulation – from 0.9 to 0.4), the Republic of Tatarstan (the trend to decrease in the index of environmental regulation is higher (from 0.4 to –0.1) than productivity index – from 0.2 to 0), in the Novosibirsk region (the same downward trends in productivity indices and environmental regulation, respectively, from 1 to 0 and from 0.5 to 0).

– multidirectional trends in the Republic of Bashkortostan (upward trend in the environmental regulation index from 0.1 to 0.3 and downward trend in the productivity index from 3 to –1).

Fig. 3 shows the data on changing the trend values taking into account its direction: minus means a downtrend, plus means an uptrend. The values along the ordinate axis are the trend of the environmental regulation index, along the abscissa axis are productivity.

We interpret the results obtained using the regional clustering method, comparing the trend calculation data with the characteristics of the regions presented in Table 2.

For an industrial cluster represented by high-tech industries, agro-industrial regions, regions of the military-industrial complex and the hydrocarbon sector, there is a direct relationship between the growth of the environmental regulation index and the productivity index, that is, the hypothesis of the absence of environmental and economic disparity is confirmed. At the same time, in general, the selected regions are characterized by a decrease in spending on environmental regulation, it is typical and systemic only for high-tech regions, with a strong developed sector of scientific research, with their close connection

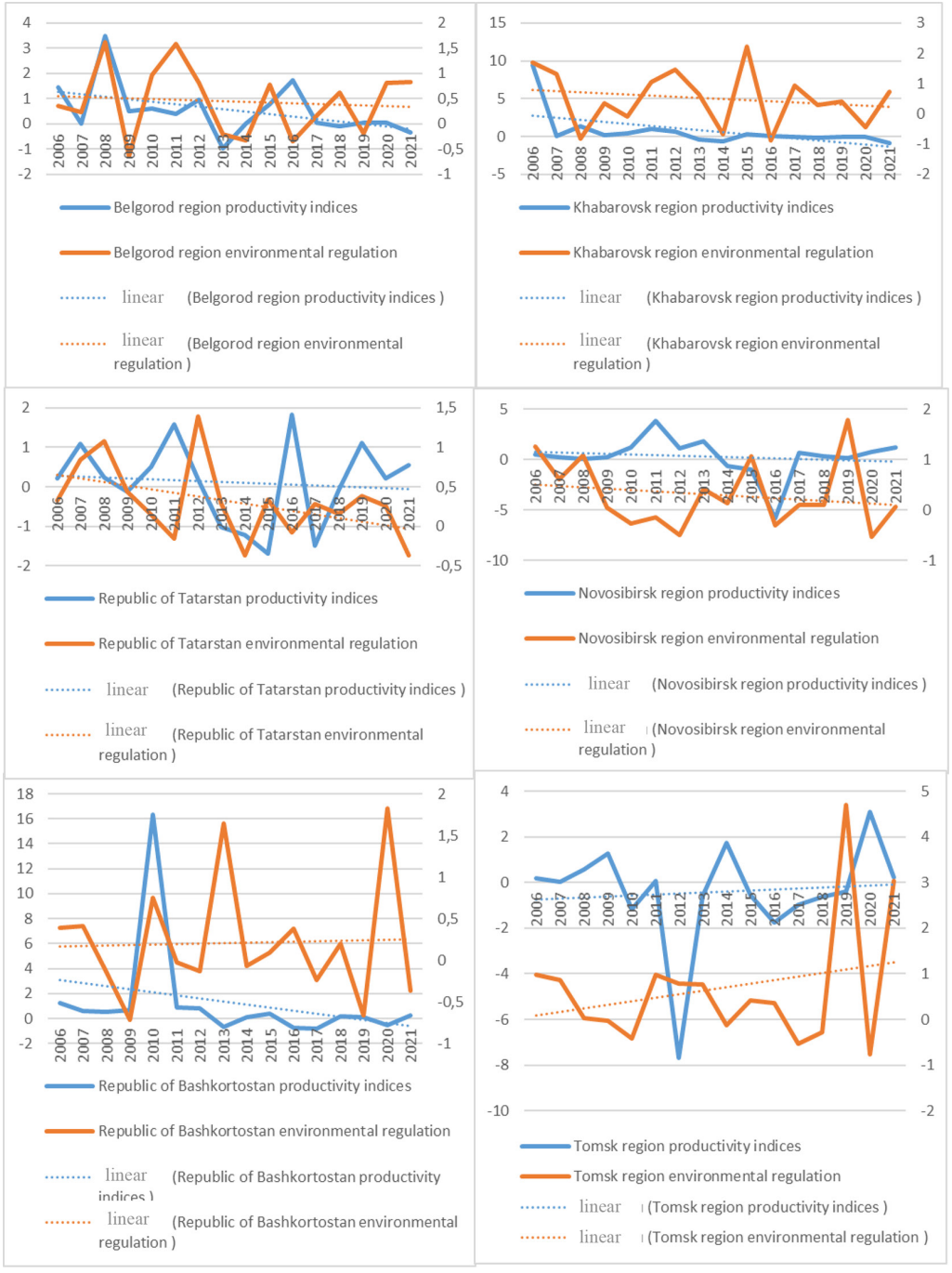

Fig. 2. Dynamics and trends of productivity and environmental regulation indices (calculated by the authors)

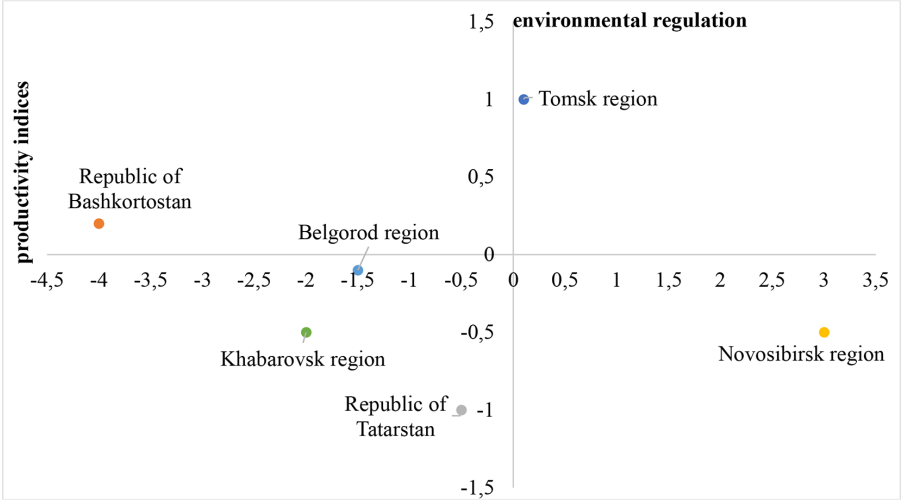

Fig. 3. Coordinates of the relationship between changes in trends in productivity indices and environmental regulation (calculated by the authors)

with production. In the sample, this situation is noted for the Tomsk and Novosibirsk regions. Obviously, the environmental regulation index is only one of the factors associated with the productivity index. However, the data obtained provide indirect confirmation of the hypothesis of Porter M.

A feature of the selected regions is downward trends for the environmental regulation index. That is, in general, current and capital investments in environmental protection are declining. As a result, risks for the ecological situation in large regions of the country are increasing, which is also fraught with problems in other areas: social, economic.

Thus, it is obvious that the choice and contradictions between ecology and economic efficiency should not stand, since the increase in the costs of environmental regulation does not lead to a decrease in productivity. At the same time, there is the prospect of achieving productivity growth with a time lag (given that environmental costs are only one of the factors).

Discussion

As a result of the study, the goal was achieved: the absence of ecological and economic disparity was proved on the example of the subjects of the Russian Federation from the point of view of the hypothesis of M. Porter. It was determined that there is no need to reduce and not increase environmental protection costs, considering that this reduces the efficiency of companies in the region. The results obtained contribute to the justification of development policy both at the micro level and at the regional level, bringing the environmental agenda to the same level as economic and social development, confirming the possibility of sustainable development and the absence of contradiction between these goals. The results obtained at the company level will be the rationale for the implementation of the ESG strategy. The study proved that a decrease in the environmental regulation index (environmental protection costs) does not lead to an increase in the productivity index and vice versa. Thus, part of the hypothesis about the absence of ecological and economic disparity has been proven. M. Porter's hypothesis based on the data of the Russian regions could not be fully proved, since in the selected regions there is a decrease in the environmental regulation index. The data obtained are consistent with the results of research by scientists on the example of China and the OECD countries.

Conclusion

In the development of the results of the study, it is possible to continue proving a di-

Table 3. Index of productivity of the regions of the study sample for 2006–2021

Region	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Russian Federation	0,8087	0,6227	0,6856	0,0124	0,8681	1,5086	0,5042	-2,1312	14,3858	-1,1315	0,5251	0,1124	0,6725	0,1561	-4,4268	0,1938
Belgorod region	1,4493	0,0255	3,4806	0,5138	0,6176	0,4166	0,9787	-0,9713	0,0119	0,7890	1,7447	0,0465	-0,0986	0,0633	0,0447	-0,3441
Republic of Bashkortostan	1,2628	0,5806	0,5156	0,6613	16,3393	0,9078	0,8069	-0,6745	0,1161	0,3540	-0,7812	-0,7848	0,1634	0,1211	-0,5269	0,2443
Republic of Tatarstan	0,2125	1,0745	0,2266	-0,1350	0,4964	1,5884	0,1792	-1,0228	-1,2231	-1,6819	1,8238	-1,4985	-0,0787	1,1077	0,2061	0,5429
Novosibirsk region	0,5174	0,2702	0,0819	0,2106	1,1948	3,8049	1,1455	1,7869	-0,6012	-1,0052	-5,7860	0,6701	0,3562	0,1085	0,7300	1,1840
Tomsk region	0,1781	0,0183	0,5746	1,2732	-1,1573	0,0504	-7,6809	-0,5824	1,7372	-0,5377	-1,7580	-0,9995	-0,6300	-0,3849	3,1021	0,2277
Khabarovsk region	9,4850	0,1189	1,3218	0,2388	0,4398	0,9669	0,6433	-0,4429	-0,6501	0,2952	0,1165	-0,0863	-0,2041	-0,0169	0,0053	-0,8703

Calculated by the authors.

Table 4. Index of environmental regulation of the regions of the study sample for 2006–2021

Region	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Russian Federation	0,1523	0,2746	0,1993	-0,0940	0,1947	0,0119	0,3120	0,1291	0,2234	-0,0091	0,1172	0,2314	0,0676	0,2059	0,1499	0,4941
Belgorod region	0,3561	0,2336	1,6126	-0,6441	0,9707	1,5822	0,8162	-0,2105	-0,3324	0,7810	-0,3436	0,1693	0,6284	-0,1784	0,8193	0,8230
Republic of Bashkortostan	0,3855	0,4122	-0,1326	-0,7166	0,7513	-0,0294	-0,1321	1,6417	-0,0628	0,0937	0,3747	-0,2373	0,1946	-0,6645	1,8274	-0,3630
Republic of Tatarstan	0,3208	0,8400	1,0757	0,4406	0,1452	-0,1538	1,3912	0,2877	-0,3663	0,3369	-0,0817	0,2802	0,1577	0,3805	0,2550	-0,3641
Novosibirsk region	1,2535	0,6111	1,0788	0,0416	-0,2754	-0,1490	-0,4983	0,4180	0,1423	1,0591	-0,3124	0,0928	0,1031	1,7811	-0,5352	0,0651
Tomsk region	0,9690	0,8605	0,0296	-0,0246	-0,4138	0,9727	0,7863	0,7739	-0,1249	0,4188	0,3592	-0,5419	-0,2783	4,6970	-0,7705	3,0296
Khabarovsk region	1,6880	1,3152	-0,8190	0,3382	-0,0888	1,0582	1,4622	0,6521	-0,6689	2,2278	-0,8873	0,9331	0,2995	0,4099	-0,4282	0,7372

Calculated by the authors.

rect relationship between the environmental regulation index and the productivity index at the level of individual companies that are large. Including a promising area of research will be the study of the impact of the transition to environmental innovation in these companies and the results of their activities in subsequent years.

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