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TRANSFORMATION OF THE TERRITORIAL AND SECTORAL STRUCTURE OF INDUSTRY OF THE REPUBLIC OF BELARUS

The purpose of the study is to identify and characterize the transformation processes that occurred in the territorial and sectoral structure of the industry of the Republic of Belarus from 1990 to 2018. The study was conducted on the basis of the use of original database of industrial enterprises created by the author. The methodical algorithm of the economic and geographical analysis of changes in the territorial-branch structure of the industry on the basis of an estimation of territorial concentration, territorial differentiation of manufacture and accompanying structural changes is offered. As a result, the author came to the conclusion that a robust center-peripheral stratification of the territorial-sectoral structure has developed with the formation of the Minsk industrial agglomeration given a growing number of industrial enterprises and nodal elements in Belarus over the period of the research. This requires the development of directions for improving the territorial organization of society and regional policy in the country. The novelty of the study is determined by the first economic and geographical analysis of transformational changes in the territorial and sectoral structure of industry of the Republic of Belarus for the entire period since the proclamation of sovereignty. This analysis is based on the use of the author's database on the number of large and medium-sized industrial enterprises. On the one hand, it is characterized by a number of limitations, but, on the other hand, it has a practical advantage in relation to other works on similar subjects.

Keywords: industrial geography; territorial and sectoral structure; transformation; concentration; differentiation; structural changes; Republic of Belarus.

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ТРАНСФОРМАЦІЯ ТЕРИТОРІАЛЬНО-ГАЛУЗЕВОЇ СТРУКТУРИ ПРОМИСЛОВОСТІ РЕСПУБЛІКИ БІЛОРУСЬ

Мета дослідження – виявлення й характеристика трансформаційних процесів, які відбулися в територіально-галузевій структурі промисловості Республіки Білорусь за період з 1990 року по 2018 рік. Дослідження проведено на основі використання авторської бази даних за кількістю промислових підприємств. Запропоновано методичний алгоритм економіко-географічного аналізу змін у територіально-галузевій структурі промисловості на основі оцінки територіальної концентрації, територіальної диференціації виробництва та супутніх структурних зрушень. Обґрунтовано висновок, що за період дослідження в Білорусі при збільшенні кількості промислових підприємств і числа вузлових елементів склалася стійка центр-периферійна стратифікація територіально-галузевій структурі з формуванням Мінської промислової агломерації. Це потребує розроблення напрямів вдосконалення територіальної організації суспільства і регіональної політики в країні, у тому числі із застосуванням напрацювань географічної науки.

Ключові слова: географія промисловості; територіально-галузєва структура; трансформація; концентрація; диференціація; структурні зрушення; Республіка Білорусь.

Relevance of the research

As of today the industry is the main branch of specialization of the Republic of Belarus, just like in the period of the collapse of the USSR. In 2018 over 1 million people were employed in industry (1028.6 thousand people or 23.7 % of the total employed population), which produced 25.9 % of the country's gross domestic product [1]. However, it has gone through fundamental changes caused by a change

in the economic system, the search for its place in the international geographical division of labor and the cyclical nature of economic development [2]. These changes were reflected in all structures of the industry: reproductive, organizational, institutional, production and technological (sectoral) and territorial.

Under these conditions, the statement not only about the inheritance, but also about the invariability of the territorial structure of the industry of Belarus since the existence of the USSR still holds a strong

position due to the insufficient attention of Belarusian scientists to this issue. At the same time, the study of changes in the territorial-sectoral structure of industry forms the basis for understanding of its territorial organization, allows analyzing the motivation of business entities in locating their enterprises [3], as well as assessing the nature of transformation processes in all structural elements of the system. This ensures the relevance of the present research and is an important aspect of improving the regional industrial policy in the country.

The state of the arts of the issue, key works

The works [4, 5, 6] are devoted to the problem of transformation of the territorial and sectoral structure of industry in individual post-socialist countries. A comprehensive study of spatial changes in the industry of Central and Eastern Europe and the CIS countries was carried out by [7, 8]. Most of the named researchers note the presence of deep structural changes in industry, which are caused by the spatial contraction of industrial production in post-socialist countries under the influence of the transition to market conditions of management.

The most relevant studies of this topic in independent Belarus include the economic and geographical analysis of changes in the territorial organization of the entire economic complex [3, 9, 10], the development of the territorial structure of individual regions [11, 12], the dynamics of the territorial structure of individual subsectors and the emergence of new forms of territorial organization of industry [13, 14]. Special attention was also paid to the transformation of the territorial and sectoral structure of the economy of the Belarusian-Russian borderland in connection with the integration processes in the post-Soviet region [15-17]. At the same time, Belarusian scientists were unable to unpack the nature and extent of changes which the territorial-sectoral structure of industry underwent during the period of sovereignty, since no research was carried out on the transformation of this structure of industry as a whole in order to identify changes in the territorial concentration of production, as well as to assess the new conditions and factors in the distribution of productive forces in industry.

The purpose of the study is to identify and characterize the transformation processes that took place in the territorial and sectoral structure of industry in Belarus for the period from 1990 to 2018. To achieve this, it is necessary to widely use statistics,

quantitative research methods and methodological approaches of economic geography.

Research methods

The concept of «territorial structure of the economy» was introduced during the formation of a systemic-structural approach in economic geography in the second half of the 20th century, associated with the name of the soviet geographer I. M. Maergoiz, who first defined the territorial structure as a set of interrelated and interdependent territorial elements. The scientist proposed to consider the territorial structure as a triune, consisting of an integral-spatial (interconnected and interdependent parts of the country), multiple territorial and sectoral (complex interaction of territorial structures of individual industries), and nutritional and distribution (linear-network-nodal structure of production infrastructure) forms [18]. G. M. Lappo and P. M. Polyan added one more form to this tripartite system – a support frame, which was considered as the main integral element of the territorial structure [19, p. 235–239], and P. Ya. Baklanov came to the opinion that the first and second structures of I. Maergoiz represent a certain level of generalization of the single territorial structure of the economy, wherein the third one is its most important component [20, p. 26]. These ideas were developed in the views of A. P. Gorkin and L. V. Smirnyagin on the superposition structures of production: territorial-production (location of production and technological elements, their combination, connections and interactions within the industry), territorial and organizational (location of organizational and economic elements, their combination, connections and interactions within the industry) and spatial (morphology of industry in two-dimensional space, devoid of specific economic content) [21].

Given the above conclusions, in this work the territorial and sectoral structure of the country is understood as the interconnected and interdependent spatial arrangement and distribution of the primary elements (enterprises) of the economic system (industry) across regional subsystems. Based on this definition, the transformation of the territorial and sectoral structure of industry reveals itself in continuous quantitative and qualitative changes in the spatial relations of the primary elements of industry and its regional subsystems, caused by exogenous and endogenous changes in the international or macro-regional position of the country in the

geographical division of labor. In our opinion, the transformation of the territorial and sectoral structure, first of all, manifests itself through the territorial concentration or dispersion of production, its territorial differentiation or simplification, as well as the corresponding structural changes.

To address the set research problem, we've employed an up-to-date statistical database on the number and localization of the primary elements of the industrial system. This database was collected by the author during the period of work on his candidate dissertation [22] and updated as of 2018. It includes large and medium-sized industrial enterprises employing over 100 people, localized in a certain territory. These organizations carry out at least one stage of production of a part, assembly or finished product. This database differs from official statistics, since the latter also includes small and micro-organizations, and their localization is determined by the legal address instead of the production address. This database made it possible to carry out:

1) assessment of territorial concentration using indices:

- concentration coefficient (CR_3), calculated by the formula 1:

$$CR_3 = \sum_{r=1}^3 Y_r \quad (1)$$

where Y_r is the share of the region (r) by the number of large and medium-sized industrial enterprises (%). This coefficient is the sum of the specific gravity of the three largest regions. It is expressed as a percentage and is characterized in the following ranges: $70\% < CR_3 < 100\%$ corresponds to high concentration, $45\% < CR_3 \leq 70\%$ - to moderate concentration, and $CR_3 \leq 45\%$ - to low concentration of the industry;

- the coefficient of regional concentration (K_r) proposed by S. P. Adashkevich [23] and calculated by the formula 2:

$$K_r = \sqrt{HHI} = \sqrt{\sum Y_r^2} \quad (2)$$

This coefficient is the squared Herfindahl-Hirschman Index (HHI), expressed as a percentage and characterized in the following ranges: $K_r > 75\%$ corresponds to a very high concentration level, $50\% < K_r \leq 75\%$ to a high level, $25\% < K_r \leq 50\%$ is the average level, and $K_r \leq 25\%$ is the low level of industry concentration.

2) assessment of territorial differentiation, as a measure of the diversity and variability of the system, using:

- difference in the number of large and medium-sized industrial enterprises (N) of the last actual (2018) and base (1990) years, units;
- index number with changed weights (I_{vc}), calculated by the formula 3:

$$I_{vc} = \frac{\sum N_r^1 * Y_r^1}{\sum Y_r^1} / \frac{\sum N_r^0 * Y_r^0}{\sum Y_r^0} \quad (3)$$

where N_r^1 and N_r^0 are the number of large and medium-sized industrial enterprises in the r-region and their share for this indicator (Y_r^1 and Y_r^0) in the reporting (1) and base (0) years, respectively. For its interpretation, 100% is subtracted from the calculated value. The resulting number reflects how much the arithmetic average of the number of large and medium-sized industrial enterprises of the reporting period has changed (decreased or increased) compared to the baseline.

3) assessment of structural changes based on indices:

- the difference in the share of regions by the number of large and medium-sized industrial enterprises (Y_r) in the last actual (2018) and base (1990) years, %;

- the index of structural changes by V. M. Ryabtsev (I_R), which is calculated by the formula 4:

$$I_R = \frac{\sqrt{\sum_{r=1}^n (Y_r^1 - Y_r^0)^2}}{\sqrt{\sum_{r=1}^n (Y_r^1 + Y_r^0)^2}} \quad (4)$$

where Y_r^1 , Y_r^0 is the share of regions by the number of large and medium-sized industrial enterprises in the reporting (1) and base (0) years. The scale for assessing the differences between the two structures according to V. Ryabtsev's index has several levels: the similarity of structures ($I_R = 0.000 - 0.030$), a very low level of differences in structures ($I_R = 0.031 - 0.070$), low ($I_R = 0.071 - 0.150$), substantial ($I_R = 0.151 - 0.300$), significant ($I_R = 0.301 - 0.500$), very significant ($I_R = 0.501 - 0.700$), opposite ($I_R = 0.701 - 0.900$), the polar opposite of structures ($I_R = 0.901$ and higher) [2].

The research algorithm consists of three stages: 1) characteristics of the geographical features of the location of new enterprises in the regions of the country; 2) economic and geographical analysis of the transformation of the territorial and sectoral structure using the above indices; 3) interpretation of the results obtained and general conclusions following the research.

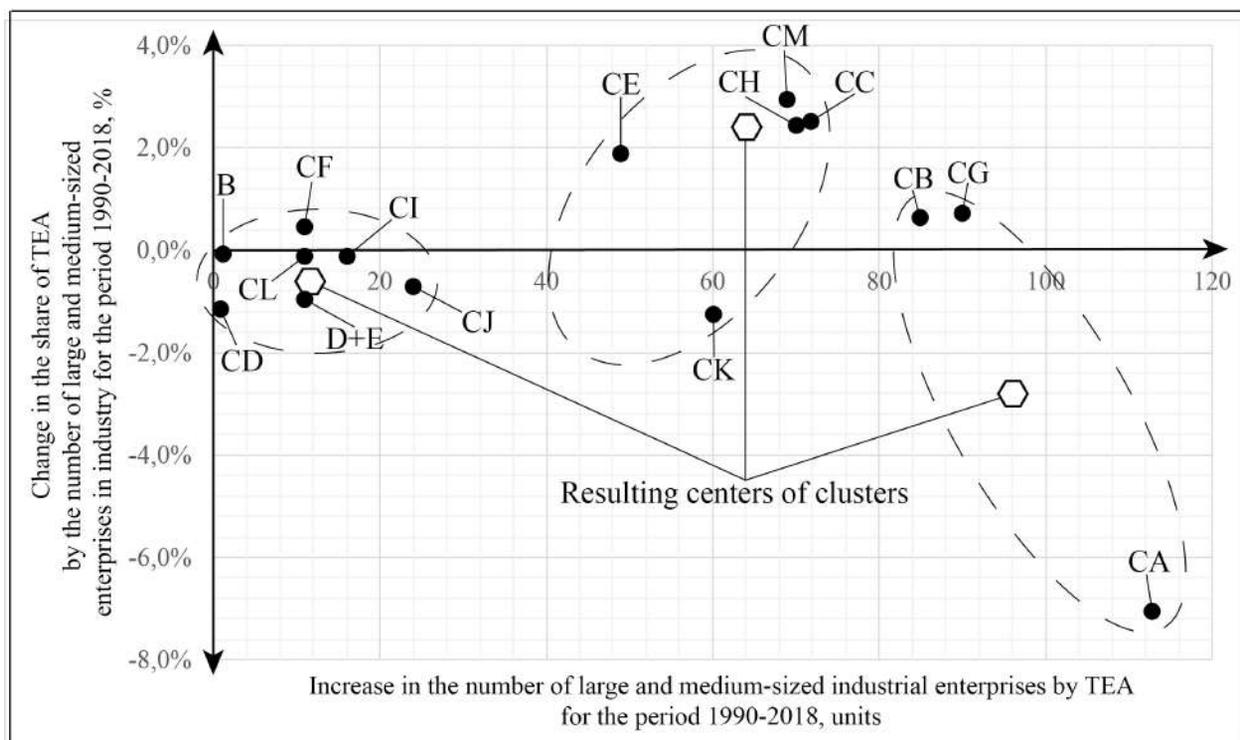


Fig. 1. Changes in the sectoral structure of industry of the Republic of Belarus by type of economic activity for the period 1991–2018

Note – Symbols of types of economic activities (TEA) are presented in the text.

Presentation of the main content with substantiation of scientific results

The transformation of the territorial and sectoral structure is due to the economic system which has emerged and functions in the country now. It obeys its laws and depends, on the one hand, on its stability, and on the other hand, on its ability to perceive and quickly adapt to changing environmental conditions [2, 3, 5, 6]. The main criterion reflecting these changes is the dynamics of structural elements. The collected statistical data show that in 2018 relative to 1990, the total number of new enterprises (N) increased by 683 units and amounted to 1527 units. This indicates a significant increase in the number of structural elements and suggests the presence of transformation processes in the industrial system of the Republic of Belarus. We carried out a k-means cluster analysis based on the indicators of the difference between the number of large and medium-sized industrial enterprises (units) and the modulus of their share (%) in the context of types of economic activities (TEA) for the period 1990–2018. As a result, the above assumptions were confirmed. This allows us to distinguish three groups (clusters) according to the specific features of changes in the sectoral structure of the country's industry (**Fig. 1**).

The first group includes the following types of economic activities: food production (CA – the share in the sectoral structure of industry by the number of large and medium-sized enterprises was 32.3 % in 1990 and 25.3 % in 2018, respectively), goods and clothing (GD – 11.0 % in 1990 and 11.7 % in 2018), and the production of rubber, plastic products and building materials (CG – 11.6 % in 1990 and 12.3 % in 2018). They are characterized by high rates of opening new industrial enterprises (more than 80 units) with their average values of changes in the share in the sectoral structure of industry for the study period, except for food production, the decrease in the share of which was maximum (-7.1 %). These types of economic activity are the most attractive for small and medium-sized businesses due to the high rate of return on entrepreneurial activity and consumer focus on the primary needs of the local population.

The second group includes five types of economic activity: the production of wood and paper products (CC – 5.0 % in 1990 and 7.5 % in 2018), the production of chemical products (CE – 3.0 % in 1990 and 4.8 % in 2018), metallurgical production (CH – 4.9 % in 1990 and 7.3% in 2018), production

of machinery and equipment (CK – 11.6 % in 1990 and 10.3 % in 2018) and the production of other finished products (CM – 3.6 % in 1990 and 6.5 % in 2018). They are characterized by indicators of the opening of new industrial enterprises over 40 units, with a high increase in their value in their share in the sectoral structure of industry, except for the production of machinery and equipment (-1.3 %). All the presented types of activity during the period of sovereignty were mainly characterized by a stable demand for domestic products in the domestic market, as well as by trade on international markets. This can be explained both by the availability of local raw materials, which create absolute advantages, and skilled labor resources and production assets, which offer comparative advantages for the products of these industries. These circumstances created additional incentives for potential investors to develop production within the country.

The third group consists of 8 types of economic activity: mining (B – 0.4 % in 1990 and 0.3 % in 2018), production of coke and petroleum products (CD – 2.7 % in 1990 and 1.6 % in 2018), pharmaceutical production (CF – 0.6 % in 1990 and 1.0 % in 2018), production of computing, electronic and optical equipment (CI – 2.6 % in 1990, and 2.5 % in 2018), production of electrical equipment (CJ – 5.1 % in 1990 and 4.4 % in 2018), production of vehicles (CL – 1.9 % in 1990 and 1.8 % in 2018) and co-generation and distribution of electricity and water supply (D+E – 3.8 % in 1990 and 2.8 %

in 2018). They are characterized by low rates of opening new industrial enterprises and changes in their share in the sectoral structure of industry. These types of economic activity are distinguished by high dependence on sources of raw materials, capital intensity of production and long-term turnover of working capital, with their predominant export orientation, which makes the opening of new enterprises a difficult task that requires large financial injections with confidence in the availability of stable sales channels for end products.

The above tendencies in the sectoral structure of the industry of the Republic of Belarus in terms of the number of large and medium-sized enterprises predetermined changes in the support frame of its territorial structure. Thus, there is a general increase in the number of nodal elements of the support frame (n) from 241 units in 1990 to 322 units in 2018 (Table 1). This is due to the formation of more flexible principles for the location of enterprises (from minimizing costs to maximizing profits) and decrease in the rigidity of their connection to the already functioning infrastructure. The largest number of new nodal elements was formed in the Minsk region and amounted to 48 units more in 2018 compared to 1990, the smallest number – in the Homiel and Hrodna regions (5 units, respectively).

The government's economic policy to attract foreign investment has led to the creation of new industrial spots and centers in the suburban areas of large cities, in medium and small towns, and also in rural areas (Fig. 2). The largest number of enterprises

Table 1.

Main indicators of the development of the key elements of the territorial and sectoral structure of the industry of the Republic of Belarus by regions for the period 1990–2018

Regions	S, sq.km	n, units		$\bar{r} = \sqrt{S/n}$	
		1990	2018	1990	2018
Brest region	32 639	35	45	30.5 km	26.9 km
Viciebsk region	39 973	44	50	30.1 km	28.3 km
Homiel region	40 370	41	46	31.4 km	29.6 km
Hrodna region	25 127	34	39	27.2 km	25.4 km
Minsk region including Minsk	40 202	63	111	25.3 km	19.0 km
Mahilioŭ region	29 276	24	31	34.9 km	30.7 km
<i>Republic of Belarus</i>	<i>207 587</i>	<i>241</i>	<i>322</i>	<i>29.3 km</i>	<i>25.4 km</i>

Note – Legend: S – area of the region (sq.km.); n – the number of nodal elements (units); \bar{r} – the average distance between the nodes (km)

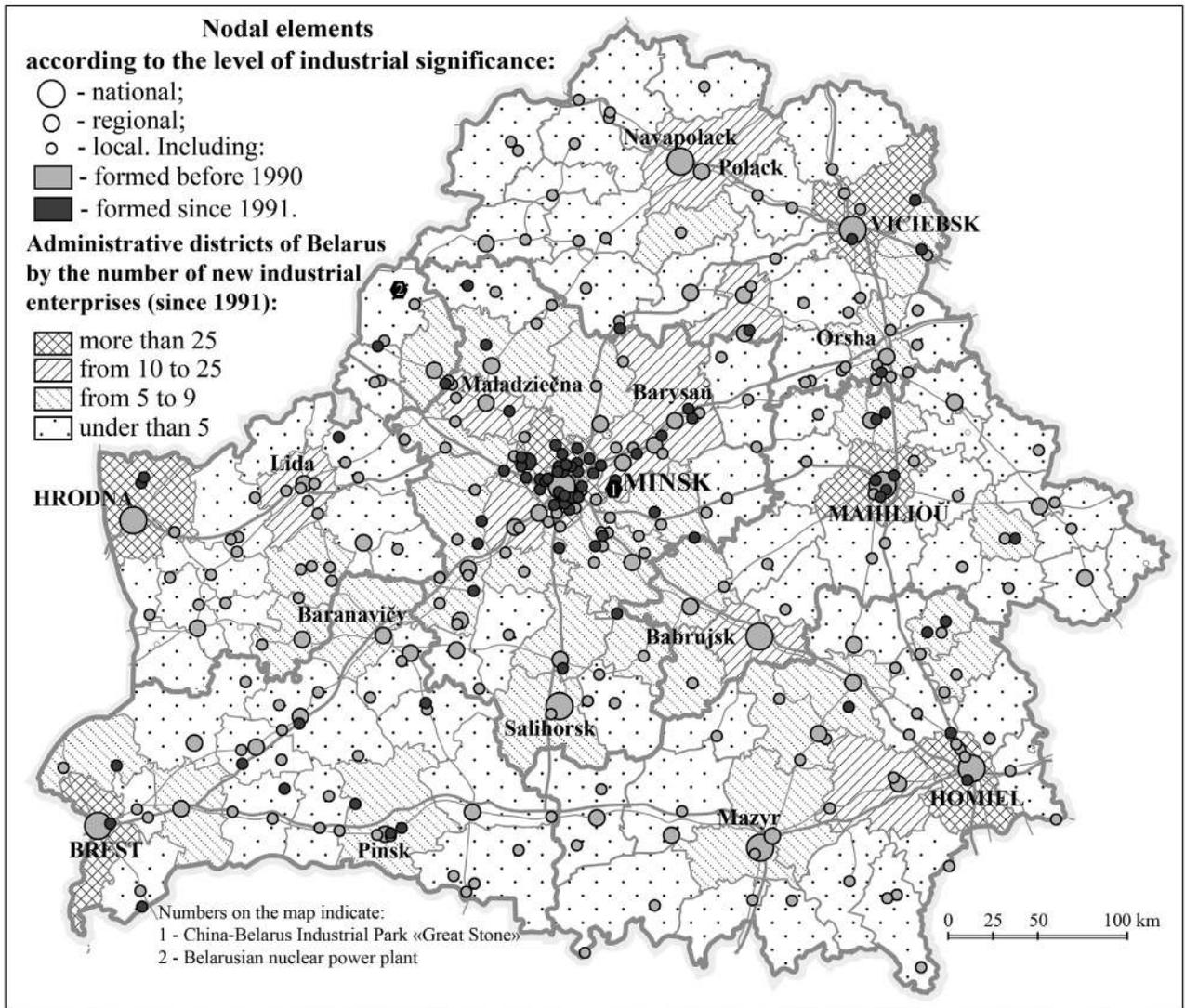


Fig. 2. Changes in the support frame of the territorial and sectoral structure of the industry of the Republic of Belarus for the period 1991–2018

was opened in the immediate geographical vicinity of the capital in the Minsk region (Baraŭliany, Hatava, Zaslaŭje, Źdanovičy, Kalodzišča, Mačuliščy, Novy Dvor, etc.). This tendency is triggered by the creation of preferential economic conditions for investors in these territories by the government. As a result of the predominant opening of enterprises in the Minsk region, where the average distance between the nodal elements of the support frame (\bar{r}) decreased from 25.3 to 19.0 km (Table 1), there have been significant changes in its spatial pattern, which has been transformed from a uniform to the agglomeration-nodal one accompanied by the formation of the Minsk industrial agglomeration.

The above transformation processes have shaped the regional structure of the Belarusian industry

in terms of the number of large and medium-sized industrial enterprises in 1990–2018. They are presented in Table 2.

Firstly, the territorial concentration of industry over the entire study period decreased insignificantly ($CR_3 = -0.7\%$, $K_r = -0.1\%$), remaining within the average level. These changes occurred despite a significant increase in the share of the city of Minsk (+3.2%) and the Minsk region (+1.7%) with a concomitant largest decrease in the Brest region (-1.5%). Secondly, the territorial differentiation of industry has increased significantly. On average, the number of large and medium-sized enterprises in each region increased by about 100 units, with the highest rate in Minsk (146 units) and the smallest in Mahilioŭ (72 units) regions. The arithmetic mean

Table 2.

Changes in the regional structure of industry of the Republic of Belarus by the number of large and medium-sized enterprises for the period 1990–2018

Regions / Years	1990		2000		2010		2018		2018–1990	
	N	Y_r	N	Y_r	N	Y_r	N	Y_r	N	Y_r
Brest region	133	15.8%	173	14.7%	208	14.9%	218	14.3%	85	–1.5%
Viciebsk region	120	14.2%	160	13.6%	187	13.4%	204	13.4%	84	–0.9%
Homieĺ region	143	16.9%	180	15.3%	209	14.9%	244	16.0%	101	–1.0%
Hrodna region	113	13.4%	145	12.4%	167	11.9%	189	12.4%	76	–1.0%
Minsk	86	10.2%	165	14.1%	194	13.9%	205	13.4%	119	+3.2%
Minsk region	148	17.5%	229	19.5%	275	19.7%	294	19.3%	146	+1.7%
Mahilioŭ region	101	12.0%	122	10.4%	158	11.3%	173	11.3%	72	–0.6%
<i>Republic of Belarus</i>	<i>844</i>	<i>100.0%</i>	<i>1174</i>	<i>100.0%</i>	<i>1398</i>	<i>100.0%</i>	<i>1527</i>	<i>100.0%</i>	<i>683</i>	<i>–</i>
CR_3	50.2 %		49.6 %		49.5 %		49.5 %		–0.7 %	
K_r	38.4%		38.4%		38.4%		38.3%		–0.1 %	
I_{vc}	0		140 %		166 %		181 %		–	
I_R	0		0.067		0.067		0.056		–	

Note. Legend: N – the number of large and medium-sized industrial enterprises (units); Y_r – share of regions by the number of large and medium-sized industrial enterprises (%).

of the number of large and medium-sized industrial enterprises in 2018 compared to 1990 increased by 81% ($I_{vc} = 181\%$), which confirms this conclusion. This is due to the formation of market conditions in the country. Under these conditions, there is a constant emergence of new product niches with continuous natural selection among enterprises. Thirdly, the shifts in the regional structure of Belarusian industry in the number of large and medium-sized enterprises over the period 1990–2018, according to V. Ryabtsev's assessment of differences, are interpreted as very low ($I_R = 0.056$). This is due to the high inertia of space and dependence on the created infrastructure, despite the above changes.

Conclusion

The main trends in the transformation of the territorial and sectoral structure of the Republic of Belarus for the period from 1990 to 2018 include:

1) A significant increase in the number of primary elements of the industrial structure from 844 to 1527 units, especially in activities aimed at meeting the internal needs of the population, and a concomitant increase in the number of nodal elements of the support frame from 241 to 322 units, respectively.

This is due to changes in the existing economic system and the country's entry into the Eurasian Customs Union (since 2015 in the EAEU) and reflects its high territorial differentiation.

2) Minor changes in the regional structure of industry in terms of the number of large and medium-sized industrial enterprises, which are characterized by the actual invariability of the level of territorial concentration of production ($CR_3 = -0.7\%$ and $K_r = -0.1\%$, respectively) and very low structural shifts ($I_R = 0.056$). This is due to the high inertia of space and the dependence of production on the development of the accompanying infrastructure.

The economic and geographical analysis of the transformation of the territorial and sectoral structure of the industry of Belarus indicates that a stable center-peripheral model of relations has developed in the country. In this model, the Minsk industrial agglomeration is given the role of the economic center. Regional centers, cities with a population of 100 thousand people and administrative districts, which link the EU countries and the Russian Federation within the trans-european transport and communication corridor No. 2 (Brest – Orsha),

are of semi-peripheral importance. The rest of the territory, where new production facilities are opened rather rarely, is the periphery of the territorial and sectoral structure of industry. The results obtained are of high practical importance when clarifying the implemented medium and long-term state forecasts and programs of socio-economic development of the Republic of Belarus and developing new ones. High stratification of the territorial organization of industry is characteristic of most countries with an emerging market economic system. However, as applied to Belarus, this tendency requires a corresponding improvement in regional policy with a gradual transition from a uniform to a stimulating principle of distribution of funds among regions

and a closer attention of the state to the use of their internal potential. This is difficult to achieve without giving the regions greater management powers.

The novelty of the study is determined by the first economic and geographical analysis of transformational changes in the territorial and sectoral structure of industry of the Republic of Belarus for the entire period since the proclamation of sovereignty. This analysis is based on the use of the author's database on the number of large and medium-sized industrial enterprises. On the one hand, it is characterized by a number of limitations, but, on the other hand, it has a practical advantage in relation to other works on similar subjects.

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