DOI: https://doi.org/10.30525/978-9934-26-191-6-15

Zakharii Varnalii
Doctor of Economic Sciences, Professor,
Professor at the Department of Finance
Taras Shevchenko National University of Kyiv
Olga Shevchenko
Doctor of Economic Sciences, Assistant Professor,
Professor at the Department of Regional Studies and Tourism
Kyiv National Economic University named after Vadym Hetman

METHODOLOGICAL APPROACHES TO THE ASSESSMENT OF RELATIONS BETWEEN REGIONS ACCORDING TO THE INDICATORS OF IMBALANCES IN THEIR SOCIO-ECONOMIC DEVELOPMENT

Summary

The disproportionality of socio-economic development of the regions of Ukraine according to various indicators causes considerable research attention to the issues of its measurement and interpretation. In particular, it is important to study the relationships between regions by levels of imbalance, as well as the impact of imbalances on the overall socio-economic regional development. The subject of this study is the assessment of the variability and level of interconnectedness of territories by indicators of regional imbalances. The stochasticity of imbalance indicators implies the use of economic and mathematical methods to study their dynamics. It is also necessary to determine the degree of strength of each imbalance indicator, taking into account the current state of control of imbalances. It is advisable to assess whether the current state of imbalances will be a favorable basis for the development of the situation. The results of the spatial and dynamic assessment of imbalances in the cluster groups of regions by development areas will contribute to the formation of appropriate management decisions. Measures to regulate imbalances should be based on exploiting these differences in the pace of regional development and identifying areas for such changes. Regulatory measures are based on an adaptive model and help to slow the growth of regional imbalances.

Introduction

The regulation of socio-economic development of the regions of Ukraine is based on the principles of harmonization of interests at the level of the state, regions and communities, the effective use of domestic resources, the balance of the components of the economic and social structure of the regional economy. Such regulation is designed to ensure the disclosure of the economic

potential of the regions, meeting the needs of the population, compliance with environmental safety. The success of the regulation of regional development depends on the ability to solve the socio-economic problems of the regions, among which the leading place belongs to structural imbalances, inter-regional differences. The uneven socio-economic development of regions is their objective characteristic that determines the overall context of the resource circulation between regions, structural transformations and the implementation of regional development strategies. Imbalances not only provoke significant differences in living standards in the region, but also weaken inter-regional ties and destroy long-term economic relations between regions. In this context, important scientific-theoretical and practical means are studies in which an important role is played by the issues of managing inequality in regional development, finding criteria for assessing inequality and ways to regulate it.

There is a growing need for a comprehensive study of the nature and dynamics of inequality in order to understand its underlying nature and formulate effective measures to combat its growth. Given the stochastic nature of indicators of imbalances in the regional socio-economic development, as well as their interdependence and interrelation, the impact on indicators of regional development, it is advisable to use economic-mathematical apparatus for their analysis and evaluation. This will provide a more accurate and complete understanding of the origins and interrelationships of imbalances and their impact on the structural transformation of the regional socio-economic sphere. Therefore, it is advisable to assess the variability and level of interconnection of territories by the indicators of disproportions of regional socio-economic development.

Part 1. Theoretical foundations for assessing the variability and level of interconnectedness of regional development imbalances

The unevenness of regional development indicators, like any other property, can be regulated in order to reduce or exploit it. The formulation of principles for building a system of regulating differences in regional development should be based on a thorough analysis of the nature, causes and consequences of such differences. It is expedient to put into the system of regulation of disparities a mechanism of forecasting the level and dynamics of indicators, which will be the basis for the formation of criteria and frameworks for the regulation of these disparities. The foregoing necessitates the development of new approaches to the assessment of this inequality and its systematization for further regulation.

The renewed state regional policy in Ukraine is becoming more territorially oriented in contrast to the previous one, aimed at the territory as a whole, and is designed to solve the problems of individual territories. This will lead to an improvement in the socio-economic development of the region and the country as a whole and will help to use the potential of the regions to ensure economic growth. Structural transformation in the regions as a basis for the realization of internal potential and strategic planning of the regions today is based on the

smart specialization of the region. This will mean the need to pay more attention to the formation of economic specialization, taking into account the existing potential and opportunities for its development, the principles of service and information economy, innovative approaches to strategic and tactical tasks, a flexible and quickly adaptive system of strategic regulation. The content of regional policy on the basis of the new regionalism is shaped not only by the need to increase the role of regions in the global economic space, but also by changes in the administrative-territorial organization, the emergence of new subjects of regional policy – hromadas (communities), the need to respond to modern challenges, taking into account the principles of regional policy of the European Union – cohesion, solidarity, etc., increasing responsible attitude to resources and awareness of the need to restore them.

In the context of the need to put into practice the principles of strategic regulation of regions, the achievements of updated regional policy – more powers and resources at the hromada level and modified powers in the regions – form their increased ability to conduct an independent policy of strategic planning and cooperation. Such measures to regulate the development of regions should be focused and aimed at the goals of strategic regulation of regions, for which it is advisable to develop ways to improve them and other mutually coordinated actions.

Certain instruments of regional development regulation, such as investment, budget planning, inter-regional and inter-municipal cooperation can be institutionalized in regional development strategies. It should be noted that the investment instrument is crucial because it is more capable of reproducing the principles of the concept of new regionalism in terms of the inclusion of regions and hromadas in global financial flows. Irrational and inappropriate allocation of resources has negative consequences that result in a limited demand for goods, a decrease in personal income and savings that can be invested, a slowdown in the construction sector, and a decrease in the demand for investment resources.

Thus, it is advisable to take into account current trends in the regions, including the socio-economic links between regions, when building a disproportionality management model.

The basis for the study of regional relations by indicators of imbalance is a systematic analysis of regional problems in general and those problems that are caused by inequalities in their development. The assessment of inequality is often based on the formation of calculated multidimensional indicators, in particular, the quality of life in the country [1], and on this basis it is possible to study the evolution of trans-regional differences. Econometric methods of studying the level of inequality and its dynamics, which are suitable for thorough calculations of indicators of inequality [2; 3; 4], always provide a

clear basis for further development of managerial decisions to regulate inequality.

The ways of regulating disproportions vary in different countries, from the formation of growth zones and the development of point projects to the creation of special programs to support certain areas [5], providing special benefits for economic conditions and the implementation of various programs to overcome regional depression [6]. Often the principles of the policy of territorial development are formed on the basis of imbalance regulation [7]. Thus, the study of ways to regulate imbalances is based on a system of consistent identification of the nature of imbalances, their dynamics, assessment of their essential characteristics and understanding of the ways of their connection. At the same time, the analysis of imbalances in socio-economic development takes the leading place, since such imbalances are the basis of other imbalances and play the role of a consequence of the unevenness of other spheres of life in the region.

The assessment of imbalances in the development of regions in the spheres of their life activities is advisable to identify the sustainability of cluster formations formed on its basis, to assess their relationships, to study the impact of various dynamic factors on the indicators of imbalances. The implementation of such an assessment is based on a set of models of multidimensional statistical analysis to study imbalances in regional development. The essence of the system of assessment and measurement of imbalances in the regional socio-economic development should be presented as an algorithm of successive actions (Figure 1).

Stages 1 and 2 of the proposed set of measures were formed in detail in the article [8]. The results of testing the spatial effects confirmed the presence of spatial autocorrelation and the stability of the formed clusters of regions in the selected classes with balanced, controlled (restrained) and uncontrolled (unrestrained) disproportions in the areas of regional development.

The subject of this study is stages 3 and 4, which include an assessment of the variability and level of interconnectedness of territories by indicators of regional imbalances (stage 3) and the formation of managerial decisions to develop regulatory measures to slow the growth of regional imbalances (stage 4).

It is also necessary to determine the strength of each indicator and/or combination of indicators, given the current state of imbalances control, i.e., whether the current state of imbalance will be a favorable basis for the development of the situation.

The spatial and dynamic assessment of the disproportionality of the development of cluster groups of regions in the areas of development will have the ultimate goal of forming management decisions aimed at the development

of regulatory measures and slowing the dynamics of imbalances in the indicators of regional development.

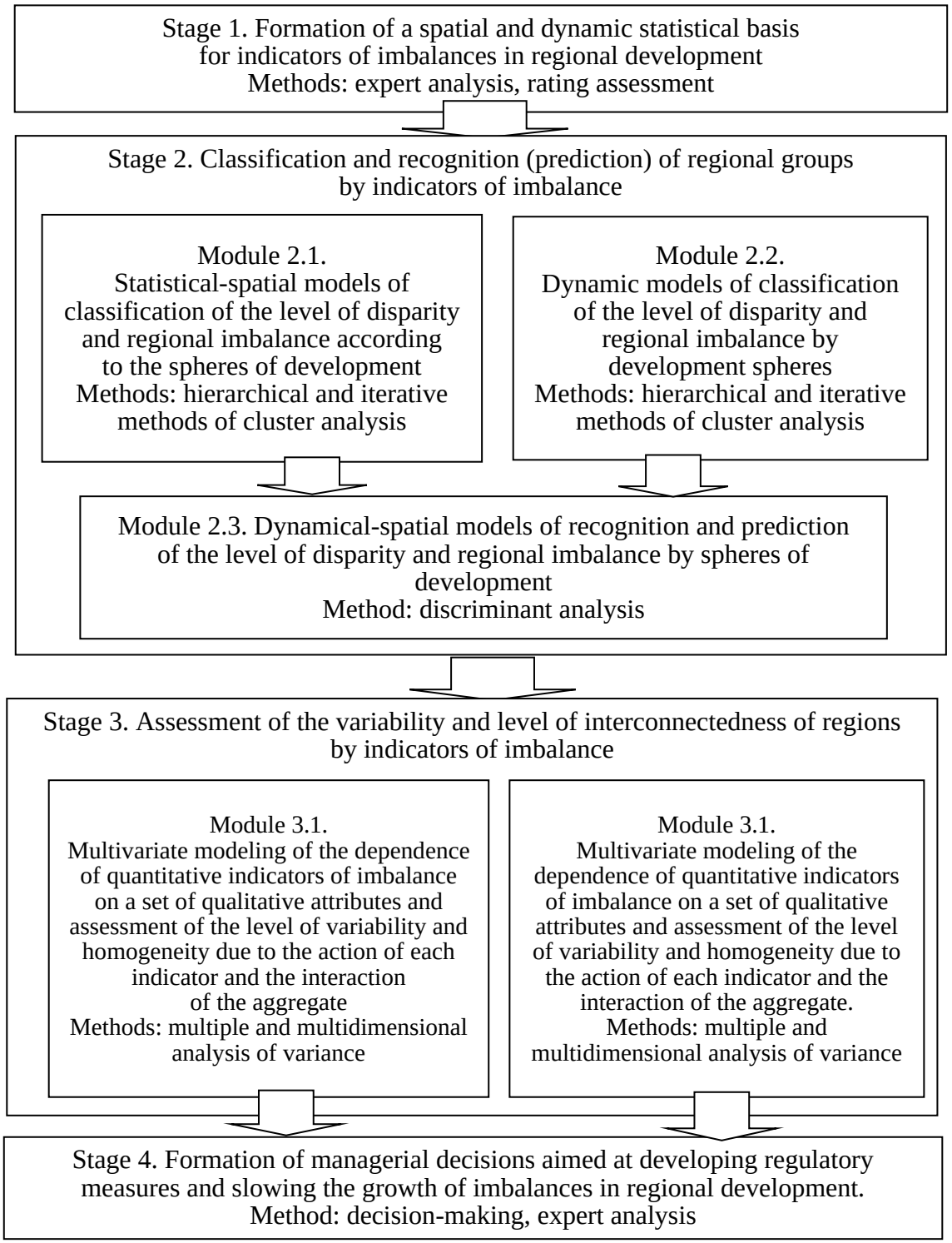

Figure 1. Methodological approach to the spatial and dynamic assessment of imbalances in the development of cluster groups in the spheres of regional life

Source: [8]

These steps to regulate inequality are the contours of a framework for examining imbalance, as well as the basic components of its regulation.

Consider the third and fourth steps of the proposed algorithm.

Part 2. Dispersion analysis of the level of variability and interrelationships of regions according to the imbalances in their development

The logic of finding interconnections between regions on the basis of the study of their imbalances (according to the indicators in different spheres of life) requires appropriate spatial and dynamic calculations of indicators. These calculations will form the basis for a picture of the cause-and-effect relationship between the disproportions in the regions and the imbalances in the spheres of life of a particular region. The aforesaid forms a clearer understanding of the essence of profound economic transformations in regional economies in order to be able to make appropriate managerial decisions in the future to adjust the structure of the economy in accordance with the needs of the market.

Given the need to use economic and mathematical methods in the interpretation of imbalances, the assessment of the variability and level of interrelationships of regions by indicators of imbalances in their development is based on the analysis of variance.

The procedure for determining the level of interrelation of regions by their imbalance indicators is based on the use of one-way analysis of variance and can be described as follows:

1. Definition of dependent and explanatory variables. By definition, an explanatory variable is a qualitatively defined trait that has two or more gradations; an explanatory variable is also called a factor that has several gradations (levels), and the dependent variable changes under the influence of explanatory variables.

One-way analysis of variance is used when studying the effect of one factor on the dependent variable.

Thus, imbalances in the spheres of regional development act as a factor (explanatory variable). The study uses three levels of factors: high, medium, low (as the results of cluster analysis). Dependent variables are quantitative indicators representing each of the areas of development that characterize the greatest quantitative dimension of imbalance.

It is useful to consider the analysis of calculations on the example of measuring the impact of socio-demographic differences in regions on the ratio between savings and GRP (gross regional product).

On the basis of the matrix formed by the distribution of the values of such indicators, which characterize the relationship between savings and GRP at the level of socio-demographic differences, the average values of dependent

variables by factor groups (high, medium and low level) were calculated (Table 1).

According to Table 1, the highest average value of the ratio of savings to GRP is achieved in uncontrolled (unrestrained) disparities in the socio-demographic sphere; the ratio of savings to GRP takes a higher average value in regions with balanced disparities in various spheres and a lower average value in regions with controlled disparities in the socio-demographic sphere.

Table 1

Mean values of the dependent variables in the groups

Levels of disparities in different spheres of regional development	Midscore (Mean value) *X13*	Standard Error (Std. error) *X13*	Number of observations *(N)*
High	0,0416	0,0426	6
Medium	-0,0553	0,0313	13
Low	-0,0383	0,0462	6

Source: calculated by the authors

2. Determination of inter- and intra-group variance.

According to the method of analysis of variance, a group mean dependent variable (x_j) was determined for each group of differences (according to the degree of influence of the factor-argument, which in this case is socio-demographic differences). Intra-group variance, which is a measure of the variability of the dependent variable within groups under the influence of unaccounted factors, is determined by formula (1):

$$SS_{intra\text{-}group} = \frac{1}{\sum_{j=1}^{p} n_j - p} \sum_{j=1}^{p} \sum_{i=1}^{n_j} (x_{ij} - \bar{x}_j)^2 \qquad (1)$$

where x_{ij} – values of indicators belonging to the *j*-th group; n_j – the volume of the *j*-th group; *p* – the number of groups into which the sample is divided, depending on the degree of influence of the factor-argument.

The inter-group variance $SS_{inter\text{-}group}$, which characterizes the scatter of the group mean relative to the sample mean *x*, which is caused by the change in the

factor-argument with regard to the number of degrees of freedom (p – 1), is determined by formula (2):

$$ss_{inter-group} = \frac{1}{p-1}\sum_{j=1}^{p}(\bar{x}_j - \bar{x})^2 \quad (2)$$

The results of the calculations are given in table 2. According to the data in Table 2, the results (on the example of indicator *X13* – the ratio of savings to GRP) are as follows:

– intragroup sum of squares ($SS_{intra-group}$) – the indicator of random variability equals 0.006;

– intergroup sum of squares ($SS_{inter-group}$) – the indicator of variability between groups (each number of n objects) is 0,039;

– the total sum of squares (SS_{total}) – a measure of the total variability of the dependent variable is 0.045.

Table 2

Results of the analysis of variance

Variance components	Unambiguous indicator results				
	Degrees of freedom	**Sum of squares *(SS) X13***	**Mean square *(MS) X13***	***p* - significance value**	***F*- allocation**
Inter-group	11	0,006	0,006	0,480	0,515
Intra-group	22	0,039	0,019	0,236	1,541
Error	22	0,281	0,012	–	–

Source: calculated by the authors

Intra- and inter-group variances for each group are calculated separately, and then these variances must be combined into a total (SS_{total}).

3. Measuring the level of exposure.

The strength of the factor's influence on the dependent variables is measured using a correlation coefficient called factorial variance (σ^2) (in the Statistics PP, this is $R2$). The formula for the calculating of the factorial variance (σ^2) is as follows (3):

$$\sigma\ 2 = \frac{SS_{inter-group}}{SS_{total}} \quad (3)$$

The value of the correlation coefficient ranges from 0 to 1.

The ratio of inter-group variability to total variability (SS_{total}) is higher if the effect of the factor is higher, and the effect of disparity on the dependent

variable is also higher. The results of the corresponding calculations are shown in Table 3.

Table 3

Assessment of the level of influence of the explanatory variable (factor) on the indicator

Indicator	**Overall result (due to the model)**					
	Factorail variance ***(R^2)***	**Corrective variance** ***(R^2)***	**Square Sum** ***(SS)***	**Number of degrees of freedom due to model)** ***(df)***	**Mean Square** ***(mS)***	**Number of degrees of freedom (residual)** ***(df)***
*X*13	0,350	0,122	0,039	2	0,019	

Source: calculated by the authors

3. Based on the data in Table 3, the level of influence of socio-demographic disparities on the ratio between savings and GRP by factorial variance is 0.35. The analysis of variance involves not only measuring the impact of different classes of inequality on the spheres of regional development, but also testing its significance.

4. Checking the significance of the results of the analysis of variance. In a one-factor analysis of variance the null hypothesis (H_0) is tested. According to the null hypothesis, the values of *x* do not depend on any source of variation. This statistic is subject to an *F*-distribution with the number of degrees of freedom (*df*). Based on the data in the *F*-statistics distribution table, it is possible to determine the critical value of the *F*-statistics (F_{Table}). The value depends on the tabulated values of the number of degrees of freedom (*df*).

If $F_{calcul} > F_{table}$, it is possible to reject the hypothesis that means the presense of influence of the factor under consideration (the effect is statistically significant).

In this case, it is impossible to reject the H_0 hypothesis that means no influence of the factor on the indicator *X13*, because $F_{calcul} < F_{table}$.

5. Interpretation of results.

Determination of the level of influence of the factors (directions of assessment of disproportions in the spheres of regional development) on other

indicators-representatives of disproportions was carried out according to a similar algorithm.

According to the results obtained by the authors, a statistically significant level of correlation was established between:

– overall economic inequality and the ratio between regional and national incomes (the variance value of the factor is 0.56);

– socio-demographic disparities and the ratio between regional and national incomes (the value of the factorial variance is 0.74);

– structural disparities and the ratio between savings and GRP (the value of the factorial variance is 0.74);

– external economic disparities and the ratio between emissions of harmful substances and the cost of environmental protection (the value of the factorial variance is 0.54);

– natural-environmental disparities and the ratio between savings and GRP (the value of the factorial variance is 0.64).

The study also conducted a two-factor analysis of variance, where combinations of the two areas of assessment of inequality in the life spheres of the region acted as factors simultaneously. According to the results of calculations, only the combination of structural and natural-environmental imbalances on the ratio of savings to GRP (*X13*) showed a statistically significant effect (0,73).

Part 3. Assessment of the degree of autocorrelation of indicators of disparities in the development of neighboring regions

The next step in the algorithm proposed in chapter 1 is to assess the degree of autocorrelation of indicators of disparities in the development of neighboring regions and to analyze the similarity of the level of differentiation in neighboring regions, as well as the stability of clusters based on spatial econometrics. As the main tasks for which methods of spatial econometrics can be applied in the formation of a strategy for balanced regional development, we can distinguish:

1) assessment of the structure and sustainability of individual regional clusters;

2) assessment of the effects of interregional cooperation on the processes of regional convergence;

3) assessment of the positive effects of interregional cooperation.

The development of methodological approaches to solve these problems is analyzed in detail in the scientific literature [2; 9; 10].

It should be noted that for many studies of regions where econometric models are used, the use of spatial econometric methods is more correct than conventional methods. Due to the specificity of many processes characterizing inter-regional relations and the effectiveness of interaction between neighboring regions, simple regression models will show significant

autocorrelation errors due to some or other socio-economic specificity of spatial data.

In this paper, the global and local Moran and Geary statistics, as well as Gettys-Horde statistics are used to assess the degree of autocorrelation of disproportionate indicators of neighboring regions and to analyze the similarity of the level of differentiation in neighboring regions, as well as the stability of clusters due to the following advantages of these models:

– spatial econometrics cancels the hypothesis of classical econometrics about the independence of observed objects;

– the studied characteristics of different objects can correlate, and this correlation is determined by geographical and spatial factors;

– spatial methodology is based on the spatial scale matrix, which shows the presence of connections between regions and their intensity.

The matrix of spatial weights is defined exogenously, so its specification is the most complex and controversial issue in modeling spatial relations. Elements of the matrix of weights can be defined on the basis of the following principles:

1) the presence or absence of common borders of the region with other regions;

2) presence or absence of nearest neighbors-regions in the region at a given distance;

3) the element of the matrix w_{ij} reflects the influence of region j on region i. All matrices of spatial scales are quadratic;

4) matrix excludes the possibility of a region's influence on itself, with zeros on the diagonal of the matrix. As a rule, the matrix of weights is standardized by rows to simplify its application procedure and improve the quality of spatial effects assessment.

Table 4

Testing global spatial effects

Indicators	2002		2008		2013		2020	
	I	***G***	***I***	***G***	***I***	***G***	***I***	***G***
*X*13	0,450	0,537	0,438	0,563	0,450	0,545	0,432	0,557
*X*21	0,249	0,772	0,223	0,775	0,196	0,804	0,157	0,831
*X*32	0,275	0,747	0,245	0,763	0,264	0,749	0,238	0,701
*X*43	0,489	0,697	0,528	0,692	0,497	0,713	0,496	0,777
*X*52	0,027	1,090	-0,028	1,097	-0,039	1,165	-0,063	1,256
*X*62	-0,106	1,238	-0,037	1,204	-0,064	1,176	0,003	0,931
*X*71	0,093	0,534	0,073	0,637	0,018	0,846	-0,055	1,548

Source: calculated by the authors

It is reasonable to consider the proposed coefficients in more detail. Moran's global statistics allows revealing spatial autocorrelation for the whole set of regions and is calculated by formula (4):

$$I = \frac{\sum_i \sum_j w_{ij} (x_i - \bar{x}) \cdot (x_j - \bar{x})}{\frac{1}{n} \sum_i (x_i - \bar{x}) \cdot \sum_i \sum_j w_{ij}}. \quad (4)$$

The expected value of the index is calculated by formula (5):

$$E(I) = -1 / (N-1) \cdot \quad (5)$$

The interpretation of the coefficient is as follows:

I> E (I) – positive spatial autocorrelation, i.e., in general, the values of the studied indicators in neighboring regions are similar;

I <E (I) – negative autocorrelation, i.e., the values of the studied indicators in neighboring regions are different;

I = E (I) – values of the studied indicators in neighboring regions are located randomly.

Moran's local statistics reveals the autocorrelation of a region with neighboring regions and is calculated by formula (6):

$$I_i = \frac{(x_i - \bar{x}) \sum_i w_{ij} (x_j - \bar{x})}{\frac{1}{n} \sum_i (x_i - \bar{x})^2}. \quad (6)$$

The interpretation of the coefficient is as follows:

I_i< *E(I)* is a negative autocorrelation for region *i*, i.e., this region differs significantly from neighboring regions in this respect;

I_i> *E(I)* – autocorrelation is positive, i.e., this region is similar in value to neighboring regions (cluster).

| I_i | > | I_j | – the similarity/difference of region *i* with its surrounding neighboring regions is greater than in the case of region *j* and its neighbors.

Global Giri statistics allows to detect spatial autocorrelation for the whole set of regions using the following formula (7):

$$I = \frac{(n-1) \cdot \sum_i \sum_j w_{ij} (x_i - x_j)^2}{\sum_i (x_i - \bar{x}) \cdot 2 \cdot \sum_i \sum_j w_{ij}}. \quad (7)$$

The interpretation of the coefficient is as follows:

0 <C <1 – positive autocorrelation, i.e., in general, the values of observations in neighboring regions are similar;

1 <C <2 – negative autocorrelation, i.e., in general, the values of observations in neighboring regions differ.

Table 4 shows the results of testing global spatial effects using Moran and Geary statistics.

The results shown in Table 4 make it possible to conclude that there is a positive spatial autocorrelation for almost all indicators of regional inequality, except for the indicators of *X52* – export coverage of imports of services, and *X71* – the ratio between the volume of innovative products and the cost of innovation in 2020.

The spatial effects allow us to investigate the local statistics in more detail. The data in Table 5 show the results of the calculations of Moran's local statistics for the year 2020.

Table 5

Moran's local statistics for 2020 data

Regions	***X13***	***X21***	***X32***	***X43***	***X52***	***X62***	***X71***
Vinnytsia	296,6	-19,9	54,2	51,8	18,1	-118,2	183,9
Volyn	16,4	22,5	10,2	37,3	-2,0	8,7	48,8
Dnipro	59,7	61,6	53,7	42,2	-9,8	50,4	-380,7
Donetsk	57,3	136,7	45,0	66,3	150,8	9,3	30,4
Zhytomyr	-24,5	29,2	3,2	40,0	-13,3	-95,9	82,2
Zakarpatska	8,7	11,3	13,4	23,3	12,0	6,7	21,5
Zaporizhzhia	51,7	30,9	75,2	183,7	47,8	-111,2	-345,3
Ivano-Frankivsk	148,6	109,9	330,4	153,2	31,7	79,4	12396,8
Kyiv	-6,2	-55,2	-35,9	-1,4	-27,3	-3,5	-637,2
Kirovohrad	-102,8	-111,9	-88,4	-253,4	-28,2	85,8	-378,8
Luhansk	126,1	-158,1	49,2	267,1	-99,5	-31,6	551,5
Lviv	-1389,3	-915,7	656,8	305,6	-11,8	-236,5	105,4
Mykolaiv	60,4	417,0	17,5	180,2	182,8	-93,9	-357,4
Odessa	209,7	-11,5	-56,4	-31,4	-61,1	-13,3	29,9
Poltava	132,9	-374,8	47,5	43,5	5574,8	29,3	-2,6
Rivne	83,3	117,1	387,7	116,1	50,2	75,1	113,3
Sumy	827,6	-54,9	-0,1	-131,3	75,1	-36,2	107,3
Ternopil	57,1	43,1	29,8	67,5	31,2	46,6	103,2
Kharkiv	139,6	8,3	356,0	177,9	920,3	560,3	-645,7
Kherson	-114,5	-168,5	-78,2	-132,0	-62,2	-167,2	51,2
Khmelnytskyi	378,7	143,1	144,2	140,1	167,0	153,9	106,5
Cherkasy	-69,6	61,6	-53,3	-292,2	-23,3	-158,9	-322,7
Chernivtsi	42,1	96,4	75,8	63,8	65,9	71,8	65,7
Chernihiv	-453,7	0,5	-44,5	-141,0	-128,7	-122,8	-418,4

Source: calculated by the authors

Note: excluding Crimea and the city of Sevastopol

Thus, in general Kharkiv region has a positive spatial autocorrelation with neighboring regions, but, unlike neighboring regions, has a significantly different level of coverage by exports of imports of services, as well as a much higher ratio of innovation and expenditures on innovation.

It should also be noted that regions with negative spatial autocorrelation (except Lviv region) create a kind of boundary between the group of regions with balanced inequality in development and the group of regions with uncontrolled (unrestrained) inequality in development.

The results of the two-factor analysis of variance revealed a statistically significant effect of only a combination of structural and natural-environmental imbalances on the relationship between savings and GRP.

Careful calculation of the dynamics of imbalances and the forecasting of their indicators should be translated into public policy measures to regulate such imbalances.

The foundations of regional development at the present stage are: a shift of emphasis on indicative medium-term planning, decentralization of authority, fiscal decentralization, the search for internal sources of investment in regional development. These mechanisms should be used in combination, because only their combination can produce a synergistic effect for regional development.

The importance of taking into account differences in the development of regional policy, the system of measures to regulate differences allows us to talk about the different degree of participation of the state and self-government in the system of influence on inequality. This indicates different ability to influence the differences.

To build the principles of regulation of differences in the development of regions, it is advisable to use the types of state regulation formed by theory – directive, indirect, normative, indicative types. The effectiveness of regulation of unevenness depends not only on the type of regulation, but also on the correctness of its application for the regulation of certain indicators.

When forming regional policy instruments regulating differences, it is advisable to determine whether regional policy should be adaptive or creative. Adaptive policy implies accelerating the process without changing its direction; in the context of regulating differences it means stimulating economic growth of underdeveloped regions. It should be noted that the stimulation of economic growth is effective when it corresponds to already defined directions of development, for which appropriate conditions have been created. For example, the location of new industries of a certain profile promotes the development of other spheres of activity if there are incentives on the part of the authorities and self-government. Conversely, the lack of economic effect in expanding growth zones or creating new conditions for employment, even with government support, can be ineffective in the long run. Creative policy implies a dramatic change in the specification of production, which may be unprofitable and

excessively resource-intensive at a certain stage of development and not consistent with the strategic goals of the region.

The emphasis on the application of adaptive policies to regulate differences is expressed in the thesis that, since the regional economy has a high capacity for self-regulation, adaptive policy measures can be effective: creation of favorable conditions for relocation, stimulation of competition, establishment of information centers for investment and training of project documentation, project auditing, development of investment passports. Such measures increase the mobility of resources, which is an important condition for balancing regional disparities. During decentralization, which is now taking place in Ukraine, the regulation of differences within different regions must differ, which leads to different strategies for each region.

Therefore, according to the model of adaptive policy, the objectives of state regulation of regional development are: better placement of enterprises, the impact on the economy of problem regions, which improves the structure of the regional economy by increasing production. Regulatory tools are divided into simultaneous, which mitigate the negative effects of market forces, and preventive, which can improve the situation in the long run. It is necessary to carry out selective regulation of various sectors of the economy depending on the economic situation.

Conclusions

The system of regulating disproportions should primarily be based on an assessment of the effectiveness of state regulation instruments. A thorough analysis of imbalances in the socio-economic development of regions should be based on their assessment using economic-mathematical methods, which provides the basis for a deeper understanding of the inequalities between the indicators of life in different regions and the relationship between regions by levels of imbalances. A broad assessment of the indicators of inequality in the development of regions based on the analysis of indicators of different spheres of life, as well as on the methods for assessing inequality is given. Using the results of cluster analysis, the variability and level of interconnection of regions by indicators of regional disparities are assessed on the basis of the analysis of variance. When analyzing the influence of a single factor on the dependent variable, a single-factor analysis of variance was used, and imbalances in the spheres of regional development served as a factor (exogenous variable). The results of spatial effects testing confirmed the presence of spatial autocorrelation and the stability of the formed clusters of regions in the selected classes with balanced, controlled (restrained) and uncontrolled (unrestrained) inequalities in the areas of regional development.

The proposed methodological approach is the basis for the analysis of the influence of dynamic factors on the imbalances in regional development, the

interpretation of imbalances and the formation of the mechanism of strategic regulation of imbalances.

Thus, regional policy at the present stage should be adaptive, involving a gradual transformation of the systems and tools for regulating the proportions of regional reproduction, restructuring their basis in accordance with the needs of the time, and in particular to solve the problems of uneven regional development.

Measures to regulate differences should be based on the following: the use of these differences in the rate of regional development, based on statistical evaluation of the rate of decline in underdeveloped and highly developed regions, and determining the direction of such changes.

References:

1. Karimi, M. S., Karamelikli, H., and Heidarian, M. (2020) Impact of an economic development plan on regional disparities in Iran. *Area development and policy*. Vol. 5, no. 1, pp. 75–88.

2. Dubrovina, N. A. (2020) Primeneniye metodov prostranstvennoy ekonometriki v regional'nykh issledovaniyakh [Application of methods of spatial econometrics in regional studies]. *Business Inform,* no. 5 (2), pp. 12–16.

3. Omelchenko, O. I. (2016) Otsinyuvannya dyferentsiatsiyi ekonomichnoho rozvytku rehioniv Ukrayiny [Estimation of differentiation of economic development of Ukraine's regions]. *Socio-economic problems and the state.* Vol. 2, no. 15, pp. 5–11. URL: http://sepd.tntu.edu.ua/images/stories/pdf/2016/16ooirou.pdf.

4. Varnalii, Z., and Shevchenko, O. (2020) Determining disparities level in Ukraine's regions on the base of fuzzy-plural approach. *Economics and Region,* vol. 1, no. 76, pp. 6–14. DOI: https://doi.org/10.26906/EiR.2020.1(76).1912.

5. Iammarino, S., Rodriguez-Pose, A., and Storper, M. (2019) Regional inequality in Europe: evidence, theory and policy implications. *Journal of Economic Geography*, vol. 19, no. 2, pp. 273–298. DOI: https://doi.org/10.1093/jeg/lby021.

6. McCann, Ph. (2020) Perceptions of regional inequality and the geography of discontent: insights from the UK, *Regional Studies*, vol. 54, Issue 2, pp. 256–267. DOI: https://doi/full/10.1080/00343404.2019.1619928.

7. Zabarna, E. M. (2019) Stratehichnyi rozvytok terytoriy na osnovi podolannya rehionalnykh asymetriy [The strategic development of territories based on overcoming the regional asymmetries]. *Biznes Inform,* no. 7, pp. 101–107. DOI: https://doi.org/10.32983/2222-4459-2019-7-101-107.

8. Shevchenko, O. V. (2021) Instrumentariy rozpiznavannya ugrupovan′ rehioniv Ukrayiny za pokaznykamy dysproportsiy yikh sotsial′no-ekonomichnoho rozvytku [Toolkit for recognizing the groups of Ukraine's regionsaccording to the indicators of disparities of their socio-economic development]. *Business Inform*. Vol. 7, pp. 115–126.

9. Dorosh, V. Yu., and Pushkarchuk, I. M. (2015) Evolyutsiyno-kontseptual′nyi pidkhid do identyfikatsiyi prostorovykh aspektiv poshyrennya ekonomichnykh yavyshch. [Evolutionary-conceptual approach to the identification of spatial aspects of the spread of economic phenomena]. *Economic Forum,* no. 4, pp. 6–11.

10. Korol, V. S. (2008) Balansovi mizhrehional′ni modeli v analizi sotsial′no-ekonomichnykh zviyazkiv [Balance interregional models in the analysis of socio-economic relations]. *Economic analysis: science journal,* no. 3 (19), pp. 51–55. URL: www.econa.at.ua/Vypusk_3/korol.pdf.