ECONOMIC SECURITY MANAGEMENT AT THE MESO-LEVEL: METHODOLOGICAL AND LEGAL APPROACH

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Abstract

In current conditions, one of the main tasks of state and regional government bodies is to ensure economic security at the meso-level. The solution to this problem requires, on the one hand, the development of a methodological approach for the management bodies to conduct an express assessment of economic security in the region, and on the other hand, the development of directions for legal regulation of economic security at the regional level, with the aim of increasing the level of economic security of depressed regions. The purpose of the article is to substantiate a methodological approach for conducting an express assessment of the economic security of regions as a basis for making managerial decisions in this sphere, and to substantiate the directions of legal regulation of economic security at the meso-level. The paper proposes the key indicators for the express assessment of economic security at the regional level. The authors have analyzed methodological approaches, which are available in economic science and practice, to the analysis of the level of economic security of the country and regions. The expediency of using cluster analysis for express assessment of regional economic security has been substantiated. The effectiveness of this approach has been tested on the example of the regions in Ukraine. A cluster analysis was performed for each individual indicator of economic security, as well as for all the five indicators. Leaders and outsiders in terms of economic security were identified. It has been proven that the economic security of the regions is determined by the results of their activities, the creation of the foundations by the governing bodies for the development of production and investment, employment and income of the population. The article has proposed directions of legal regulation of economic security in Ukraine, aimed at leveling threats to economic security and creating a favorable institutional and economic environment in the depressed regions of Ukraine.

Keywords: cluster, economic security, legal regulation, management, region
JEL classification: C1, K0, H70, R13, R50

1. Introduction

The economic security of a region, on the one hand, is an important component of national economic security and, on the other hand, an object of management by central and regional authorities. The socio-economic development of a regional economic system determines the

economic and financial independence of the regions, their ability to withstand internal and external threats, the capability to maintain economic stability, rational use of available resources, quantitative and qualitative development of productive forces and production relations, and, therefore, it creates the basis for both the economic security of the regions and the economic security of the national economy on the whole.

At the same time, the importance of maintaining and improving a certain level of economic security necessitates choosing a system of tools and methods for managing the economic security of the region, which would determine the economic entities' choice of the most effective of the available alternatives and the way to resist internal and external threats. It is a matter of choosing such management tools that would ensure the harmonization of economic interests at the micro-, meso- and macroeconomic levels, solve the problem of limitless needs and limited economic resources, form institutional constraints and, at the same time, opportunities for economic actors, meet both the principles of economic freedom and the norms and rules of economic behavior. Thus, the economic security of the regions is the object of management by regional and central government bodies.

Assessing the level of economic security of regions is an important and relevant scientific task, whose solution allows for effective management of economic security of regions in the short and long term, during periods of economic crisis and depression and under increasing internal and external threats and risks. On the other hand, this makes it necessary for the governing bodies to provide effective legal regulation of economic security at the regional level. It is about creating an appropriate institutional environment that would be aimed at supporting the socio-economic development of the leading regions, the formation of a favorable investment climate, and reducing internal and external risks in the depressed regions.

1.1. Literature review

In the scientific literature, the issue of methodological approaches to assessing the level of economic security at the macroeconomic level has been given considerable attention. However, the methodological principles of assessing and analyzing the economic security of regions require further development. In European countries, the United States, China and other countries, more attention is paid to assessing the security of the country in general and economic security in particular, rather than the economic security of regions, since the need to address the problem of economic growth and sustainable economic development is in focus [Losman 2001; Assemblee Nationale France 2004; Economic and Commercial Counselor's Office China 2008; Yong 2008; Luciani 1988; Cable 1995; Kirshner 1988; Belyakova et al. 2018; Koudoumakis et al. 2019]. To assess the level of economic security of regions, they use the same methodological approaches and indicators as for national economic security, since the problems of economic security of regions are not decisive for these countries. In particular, the following main approaches to the analysis of economic security used in European countries can be distinguished:

1) Nordstat's methodological approach is based on the identification and analysis of three classes of indicators: class A, which is based on indicators that can be used for interstate rankings (population size, number of objects of unfinished and completed construction, number of places in educational and medical institutions, hospitals, etc.); class B: indicators that require preliminary transformations for ranking and further adjustments in order to prevent inadequate rankings (unemployment rate, environmental quality); class C: indicators that cannot be ranked (level of social benefits, income, poverty, etc.) (Nordstat 2020);

2) the methodological approach of the DTLR (Department for Transport, Local Government and the Regions, the United Kingdom, which was renamed the Department of Transport in 2002), based on monitoring indicators of the current state of the public service delivery system, targets, survey results of households' satisfaction with the quality of services and activities of local governments [Department for Transport, the United Kingdom 1998–2002]. Similar monitoring systems are also used in Sweden (LWMS - Local Welfare Management Systems), Finland (VERTI) and other developed countries;

3) methodological approach BERI (Business Environment Risk Intelligence), based on the calculation of the risk index, which is formed on the basis of analysis of 15 quantitative

indicators of the economic and political environment in an area and which determines the level of its economic security (BERI 2020);

4) methodological approach of the "Universe" company, based on an integral assessment of risk factors in the socio-political, domestic and foreign economic spheres. The conclusion on the level of economic security is made on the basis of expert and empirical assessment of these factors;

5) methodological approach of Euromoney magazine, which is based on the calculation of the integral index of the country's reliability as the sum of expert assessments of the level of economic efficiency, political risk, comprehensive debt, default, creditworthiness, availability of bank credit, short-term financing, long-term loan capital, and the probability of force majeure [Euromoney 2020; Zarova 2013; Hevesi 2003].

These methodological approaches have the following weaknesses: 1) they are based on the use of expert assessment methods, whose scores may be subjective, require additional verification, have certain limitations under conditions of unsustainable development and uncertainty of the environment; 2) they require the generation of a large array of input data, which is often a problem due to the delay in the publication of statistical information by national statistical services, which in turn impedes a prompt response from governmental bodies to challenges and threats to economic security.

A significant array of methods for assessing the economic security of regions has been proposed by present-day researchers in Ukraine and Russia [Senchagov and Ivanov 2015; Akberdina, Grebenkin et al. 2017; Rudenko 2017; Chichkanov, Belyaevskaya-Plotnik et al. 2020; Arkhipova, Kulikov 2020; Kharazishvili, Sukhorukov et al 2013]. In particular, the researchers proposed to assess the threats to the development of networked coupled industries, which together form an idea of the economic security of regions. The analysis was conducted by the indicators of each individual sphere in the region, in particular, indicators of industrial, food, energy, financial, personnel security, innovation and investment, social development, and environmental condition of the regions. The proposed methods allow identifying changes and diagnosing the presence of internal and external threats to the economic security of regions in the long run, but do not allow for express analysis and prompt solution to these problems in the short run.

Also, the researchers proposed a dynamic approach to the analysis of economic security of regions as a system that develops in space and time; the approach is implemented on the basis of comparative analysis, grouping and generalization of changes in capital investment per capita, the degree of depreciation, level of technological innovation, and human development index [Gagarina et al. 2019]. This allowed the researchers to conclude that the greatest threats to the economic security and sustainable functioning of regions arise in bifurcation points, which are characterized by instability, chaos, disorder; the findings reveal the need for the state support to the regions in these periods so that they were able to enter the path of sustainable development.

Also, the scientists who study the issues of economic security of regions, have formed a system of historical, cultural, economic, social indicators, which affect the socio-economic development of a region and reflect the factors of its economic security [Chichkanov et al. 2020].

Based on correlation and regression analysis, the researchers have concluded that the level of economic security, socio-economic status and development of the country and regions directly depend on the level of innovative development and implementation of digital technologies. This became the basis for the recommendations in the sphere of economic security management strategy based on digitalization in the context of global digitalization [Zarubei 2020].

The generalized results of the analysis of the existing methodological approaches to the assessment of economic security of regions led to a conclusion that they apply two major approaches, a factor and result approach. The factor approach is based on the use of assessment indicators, which are factors and at the same time threats to the economic security of the regions. They are, in particular, the amount of fixed capital, the availability of natural resources, the volume of foreign investment, the level of education and skills in the population, the state of the institutional environment, geographical location, etc.) [Samoilova 2013; Purnastuti et al. 2016; Chistnikova 2017; Batabyal 2018; Amri 2018; Myzrova 2020].

The methodological feature of this approach is the use of a large array of indicators, numbering dozens of metrics, which are the basis for the calculation of an integral index, which more fully reflects the level of economic security in the region in the opinion of its supporters.

The basis of the result approach is the assessment of economic security of regions on the basis of indicators that reveal the level of economic security achieved in the region as a result of socio-economic activities of the region. These are, in particular, indicators of the economic stability, regional income, employment and quality of life, resilience to the effects of crises, internal and external threats, etc. (Sukhorukov, Kharazishvili 2013; Pourmohammadi et al. 2014; Duran H. 2015; Correia 2017; Jayanti et al. 2019).

Despite the growing popularity of the factor approach, it has a number of significant disadvantages. In particular, the definition of an integral index is problematic, because, as a rule, the indicators used for its calculation are mainly inhomogeneous and incomparable. In addition, a large number of indicators make it difficult to make decisions and conclusions about the economic security of the regions. Furthermore, these indicators to a greater extent characterize the potential opportunities for the formation of economic security in the region and the resources and conditions that can provide it, but they do not give an idea of the security itself.

On the other hand, the result approach has significant prospects in the express assessment of the economic security condition and the formation of managerial decisions in the short term, as it involves assessing economic security based on key indicators, i.e. the results of socio-economic activities in the region, rather than a set of factors that affect it.

This approach opens up opportunities for prompt response from state and regional authorities to the problems of economic security and internal and external threats to it; it forms a methodological basis for the development of effective and efficient measures in the sphere of its regulation. This is the approach we consider the most promising for prompt assessment of economic security at the meso-level. Moreover, it will provide for a more accurate idea not only of the socio-economic results achieved in every individual region, but also of the directions of legal regulation of economic security in each of them.

In this case, the most promising methodological approach that allows such a rapid analysis, in our opinion, is the method of cluster analysis. This method is used by scientists to analyze the economic and institutional conditions in the national economy that overcome its internal and external threats (Smiesova et al. 2019), as well as to assess the possibilities of forming joint cluster groups at the enterprise and regional levels (Ivanova et al. 2020; Chairat et al. 2015 end 2020; Larionova 2018; Napolskikh et al. 2019).

1.2. Purpose

The purpose of the article is to substantiate the methodological approach for express assessment of economic security of regions as a basis for managerial decisions, as well as directions of legal regulation of economic security at the meso-level.

2. Methods

2.1. Selection of indicators

To form a methodological approach to assessing the economic security of regions, it is first necessary to justify the selection of indicators to be taken for the analysis. The major indicators for the short-term economic security assessment are presented in Table 1. In the context of the European Union's experience in assessing the level of economic security and the findings of researchers in regional economy, we propose to use GRP per capita (Gross regional product per capita) as the main indicator (P1), calculated according to the methodology of the National Accounting System [Samoilova 2013]. In the context of economic security of regions, this indicator reflects the end result of the activities and development of regions in the relevant period with reference to population, and, consequently, shows their contribution to the national economy, characterizes the level of production and distribution, final costs and consumption, the level of income and savings that have been created in the region and calculated per capita.

Employment level in the region was chosen as the P2 indicator, which characterizes the level of production development achieved in the region, the region's capability to create jobs for the able-bodied population, generate income and maintain an appropriate level of social reproduction and reproduction of the labor force. The high level of employment is the basis for the economic security of the region and reflects the level and tightness of the relationships between production and consumption in the region.

The third indicator P3 is disposable personal income per capita (Gross disposable income per head); it characterizes the level of income that can be used by the population of the region for consumption and savings, and, consequently, the level of material security, purchasing power of its population and the level of prosperity of the region as a capability to counter internal and external threats to the economy, regional differentiation of incomes, impoverishment and social tensions.

Indicator P4 is the volume of sold industrial products (goods and services) per person (Value of sold industrial production per capita); it is a characteristic of the industrial orientation of the region and at the same time the result of its production potential, stability and expansion of sales in industry, industrial development and competitiveness of industrial products, the degree of satisfaction of society's demand for industrial goods and services. These aspects are indicators of economic security (insecurity) of the region and its population, and of the effectiveness of managerial decisions in the industrial sphere.

The indicator P5 is the volume of capital investment per capita; it shows the region's capability to accumulate, attract and sell financial resources, obtain economic and social effect on the basis of investment, it characterizes the result of quantitative and qualitative renewal of production, reconstruction and modernization, and the level of innovation and investment in social facilities that meet the need of the region's population for social benefits. This indicator reflects the investment security of the region, i.e. the ability of the region to ensure expanded reproduction, technical and technological renewal, its socio-economic development, prompt response to internal and external threats, and the formation of a favorable investment climate.

2.2. Justification of the method

To assess the short-term economic security of the regions, we propose to use the method of cluster analysis based on the McKean k-means algorithm, which involves the partition of a data set into a certain number of clusters (k) by finding the cluster centroids. Vectors are divided into clusters based on the principle of minimizing the standard deviation of points in each of them and finding the smallest Euclidean distance between the object and the center.

The choice of this method is justified by its advantages. First, based on the use of this method, it is possible to establish the significance of each individual indicator in each individual period under study. Second, it is possible to avoid the inclusion of the same element (region) in several clusters and to distribute the data between non-intersecting regions. Third, it is possible to specify the number of clusters and accordingly obtain more adequate results, avoid deviations from these results and interpret them more accurately [Smiesova et al. 2019; Ivanova et al. 2020].

Weaknesses of the cluster analysis method are that: if the initial number of cluster groups is chosen incorrectly, there may be a local minimum and suboptimal distribution of data, which, in turn, can lead to incorrect results; the algorithm of the method is sensitive to data outliers and noise; the choice of different starting centers leads to different decisions. The latter aspect is due to the fact that the software package independently selects the source centers, and this determines the distribution of input data in cluster groups other than the groups selected by the researcher. Therefore, there is a need for further regrouping and adjustment of groups obtained during clustering and their additional verification by the researcher.

That is why, using this method, it is necessary to take into account the above aspects and level them.

The main stages of assessing the short-term economic security of regions on the basis of cluster analysis are presented in Table 1.

Table 1 Main indicators and stages of express assessment of economic security of regions in the short term

Indicator		Stages of assessing economic security in the short term	
P1	GRP per capita (Gross regional product per capita) – methodology by Systems of National Accounts (SNA)	**Stage 1**	Formation of a sample of statistical data for the assessment
P2	Employment level in the region - methodology by SNA	**Stage 2**	Clustering of regions by the level of each individual socio-economic indicator (P1, P2, P3, P 4, P5)
P3	GDI per head (Gross disposable income per head) – methodology by SNA	**Stage 3**	Clustering of regions by the level of the whole set of socio-economic indicators (P1, P2, P3, P 4, P5)
P4	Value of sold industrial production per capita - methodology by SNA	**Stage 4**	Assessing the level of economic security of regions in the short term, determining the state of socio-economic development of the region, its strengths and weaknesses
P5	Capital Investment per capita – methodology of national accounting		

Developed by the authors

The clustering used K-means Clustering (k-means method), the purpose of which is the partition of *a*-observations (from the space Rb) into *k* clusters, where each observation is assigned to the cluster to whose centre (centroid) it is closest. The Euclidean distance (1) is used as a measure of approximation:

$$p(m,n) = \|m-n\| = \sqrt{\sum_{p=1}^{b}(m_p - n_p)^2} \quad (1)$$

where *m, n* are *Rb*

When considering the observations (m (1), m (2),… m (a)), m (j) is Rb, the method of k-means will partition *a* observations into *k* groups (or clusters) ($k \le a$), S = {S1, S2,…, Sk} so as to minimize the total quadratic deviation of the points of the clusters from the centroids of these clusters (2).

$$\min\left[\sum_{i=1}^{k}\sum_{m^{(j)}\in S_i}\left\|m^{(j)}-\mu_i\right\|^2\right] \quad (2)$$

where m(j) is Rb, μi is Rb

μi is centroid of the Si cluster.

3. Results

The formation of the sample of statistical data (stage 1) was carried out based on our selected indicators from Table 1.

Consider the methodology of express assessment of the economic security of regions and the effectiveness of managerial decisions in this sphere in the short term on the example of the regions in Ukraine for six main periods (2009, 2011, 2013, 2015, 2017 and 2018).

The sample ends in 2018, as there are no statistics for later periods. The main sources of statistical data were statistical reports and data from statistical yearbooks of the State Statistics Service of Ukraine. The calculations were performed on the basis of the cluster analysis method using the Statistica 12 software package in the Data Maining module.

For the convenience of information processing, each region was assigned a number: Vinnytsia Region – R1; Volyn Region – R2; Dnipropetrovsk Region – R3; Donetsk Region – R4; Zhytomyr Region – R5; Zakarpatska Region – R6; Zaporizhzhia Region – R7; Ivano–Frankivsk Region – R8; Kyiv Region – R9; Kirovograd Region – R10; Luhansk Region – R11; Lviv Region – R12; Mykolaiv Region – R13; Odessa Region – R14; Poltava Region – R15; Rivne Region – R16; Sumy Region – R17; Ternopil Region – R18; Kharkiv Region –

R19; Kherson Region – R20; Khmelnytsky Region – R21; Cherkasy Region – R22; Chernivtsi Region – R23; Chernihiv Region – R24.

Given the weaknesses of the cluster approach pointed out above in the substantiation of the method, we selected 4 groups of clusters, due to preliminary empirical analysis of the data, economic content of the results to be interpreted, the results of testing and adjustment by the researchers, taking into account the sensitivity of the method to data outliers and noise.

Thus, using the cluster approach, we obtained four groups of regions according to the level of their economic security: Cluster 1 – regions with a low level of economic security, Cluster 2 – regions with a medium level of economic security; Cluster 3 – regions with the economic security level above average; Cluster 4 – regions with a high level of economic security. At stage 2, the dynamics of socio–economic indicators in the regions (P1, P2, P3, P4, and P5) was analyzed and the regions were clustered according to the level of each of these indicators.

Table 2 shows the results of clustering of the regions according to the level of GRP per capita (P1).

Table 2 Clustering of the regions by the level of P1 (GRP per capita), monetary units

	2009	cluster	2011	cluster	2013	cluster	2015	cluster	2017	cluster	2018	cluster
R1	12145	1	17768	1	22303	1	37270	2	58384	3	71104.0	2
R2	11796	1	16993	1	19817	1	30387	2	49987	2	58297.0	2
R3	27737	4	42068	4	46333	4	65897	4	97137	4	114784.0	4
R4	23137	3	36446	3	37830	3	*	-	*	-	*	-
R5	11419	1	17184	1	20286	1	30698	2	49737	2	62911.0	2
R6	10081	1	14455	1	17044	1	22989	1	34202	1	41706.0	1
R7	20614	3	27567	2	30526	2	50609	3	75306	3	85784.0	3
R8	12485	1	19386	1	24022	2	33170	2	46312	2	57033.0	2
R9	21769	3	34420	3	39988	3	60109	4	90027	4	112521.0	4
R10	13096	1	19918	1	25533	2	39356	2	55183	2	67763.0	2
R11	16562	2	25067	2	24514	2	-	-	-	-	-	-
R12	14093	2	20490	1	24937	2	37338	2	58221	3	70173.0	2
R13	17050	2	23402	2	27355	2	41501	3	60549	3	70336.0	2
R14	20341	3	25748	2	29118	2	41682	3	62701	3	72738.0	2
R15	22337	3	35246	3	39962	3	66390	4	106248	4	123763.0	4
R16	11699	1	16735	1	19003	1	30350	2	42038	2	49044.0	1
R17	13631	2	19800	1	23517	2	37170	2	51419	2	62955.0	2
R18	10240	1	15055	1	16819	1	24963	1	38593	2	46833.0	1
R19	21228	3	27966	2	31128	2	45816	3	69489	3	86904.0	3
R20	12256	1	16990	1	19311	1	30246	2	45532	2	52922.0	1
R21	11780	1	17260	1	20165	1	31660	2	49916	2	59583.0	2
R22	14393	2	21082	1	26168	2	40759	3	59697	3	76904.0	3
R23	9383	1	13228	1	15154	1	20338	1	31509	1	37441.0	1
R24	13121	1	19357	1	22603	1	35196	2	55198	2	69725.0	2

Source: Calculated by the authors based on the State Statistics Service of Ukraine for 2009–2018.

Note: * Data are missing due to the impossibility of taking into account the results of part of the temporarily occupied territories in Donetsk and Luhansk regions

Table 2 shows that in the study period there is a significant gap between the regions by P1, and accordingly in 2009 the first group (with a low rank by P1) included 14 regions: R1, R2,

R5, R6, R8, R10, R16, R18, R20, R21, R23, R24; only one region could be assigned to the group of leaders – R3. By the end of 2018, there are already three leading regions with the highest P1: R3, R9, R15, as well as five regions with the lowest level of P1 (R6, R16, R18, R20, R23). The other regions are in the group with an average level of P1 – R1, R2, R5, R8, R10, R12, R13, R14, R17, R21, R24, and a level above the average – R7, R19, R22.

It should also be noted that in dynamics, the regions R1 and R22 have significantly improved their ranking, while the situation in the regions R4 and R11, on the contrary, has deteriorated significantly, which is explained by the military actions that are being carried out in these areas, and by socio–economic and political crisis, which negatively affect their economic condition.

The results of clustering of the regions by the coefficient P2 (Employment level in the region) are presented in Table 3.

Table 3 Clustering of the regions by the coefficient P2 (Employment level in the region)

	2009	cluster	2011	cluster	2013	cluster	2015	cluster	2017	cluster	2018	cluster
R1	0.89	1	0.90	1	0.92	2	0.91	3	0.89	3	0.71	3
R2	0.91	3	0.92	3	0.92	2	0.90	2	0.88	1	0.60	1
R3	0.92	4	0.93	4	0.93	4	0.93	4	0.92	4	0.73	4
R4	0.91	3	0.92	3	0.92	2	0.86	-	0.85	-	*	-
R5	0.89	1	0.90	1	0.91	1	0.89	1	0.89	2	0.71	3
R6	0.90	2	0.90	1	0.92	2	0.91	3	0.90	3	0.65	2
R7	0.92	4	0.93	4	0.93	4	0.90	2	0.89	3	0.72	4
R8	0.91	3	0.91	2	0.93	3	0.92	3	0.92	4	0.67	2
R9	0.92	4	0.93	4	0.94	4	0.94	4	0.93	4	0.71	3
R10	0.90	2	0.91	2	0.92	2	0.89	1	0.88	1	0.68	3
R11	0.92	4	0.93	4	0.94	4	0.84	-	0.83	-	*	*
R12	0.92	4	0.92	3	0.93	3	0.92	3	0.92	4	0.69	3
R13	0.91	3	0.92	3	0.93	3	0.91	3	0.90	3	0.73	4
R14	0.93	4	0.94	4	0.95	4	0.94	4	0.93	4	0.70	3
R15	0.90	2	0.91	2	0.92	2	0.88	1	0.88	1	0.69	3
R16	0.87	1	0.90	1	0.91	1	0.90	2	0.88	2	0.68	3
R17	0.89	1	0.91	2	0.92	3	0.90	2	0.91	4	0.74	4
R18	0.89	1	0.90	1	0.91	1	0.88	1	0.88	1	0.64	1
R19	0.92	4	0.93	4	0.94	4	0.93	4	0.94	4	0.77	4
R20	0.91	3	0.91	2	0.92	2	0.90	2	0.89	2	0.72	4
R21	0.90	3	0.91	2	0.92	2	0.90	2	0.91	4	0.70	3
R22	0.89	1	0.91	2	0.91	1	0.90	2	0.90	3	0.73	4
R23	0.91	3	0.92	3	0.93	3	0.91	3	0.92	4	0.69	3
R24	0.89	1	0.90	1	0.91	1	0.89	2	0.89	2	0.74	4

Source: Calculated by the authors based on the State Statistics Service of Ukraine for 2009–2018.

Note: * Data are missing due to the impossibility of taking into account the results of part of the temporarily occupied territories in Donetsk and Luhansk regions

According to the results, eight regions are top-ranking by the indicator P2: R3, R7, R13, R17, R19, R20, R22, R24, while R2 and R18 are among the outsiders. On the whole, the employment rate increased significantly in 2018 compared to 2009.

The obtained data clearly reflect the trend to a decrease in the economically active population, its aging and depopulation occurring in Ukraine over the past 24 years. Negative reproduction of the economically active population worsens the situation concerning the use of the country's labor potential.

Table 4 shows the results of clustering according to the GDI per head indicator (Gross disposable income per head): the regions R3 and R7 are steadily in the cluster group showing the highest rates; the regions R9, R14, R15, and R19 belong to the regions with the P3 level above the average.

Table 4 Clustering of the regions by the level of P3 (GDI per head), monetary units

	2009	cluster	2011	cluster	2013	cluster	2015	cluster	2017	cluster	2018	cluster
R1	12380	2	18680	2	22715	2	28627	2	43725	3	54992	2
R2	11131	1	16391	1	19491	1	24474	1	38069	1	46475	1
R3	16647	4	23724	4	29940	4	38346	4	54215	4	72883	4
R4	17381	4	24623	4	29981	4	*	-	*	-	*	-
R5	12385	2	18429	2	21452	2	27030	2	41787	2	52136	2
R6	10028	1	14663	1	17898	1	21447	1	33282	1	40472	1
R7	16174	4	23143	4	28474	4	35379	4	52727	4	67982	4
R8	12015	2	17238	2	20964	2	25613	2	39326	2	48368	2
R9	15086	3	22408	3	26766	3	33072	3	50321	4	63498	3
R10	11758	2	17712	2	21377	2	26728	2	40877	2	51018	2
R11	14368	3	20589	3	25186	3	*	-	*	-	*	-
R12	13657	3	19240	2	22623	2	28796	2	44194	3	55511	2
R13	13298	2	19638	2	23689	2	28750	2	43852	3	55544	2
R14	12622	2	18878	2	25082	3	31568	3	48474	3	61166	3
R15	14747	3	20485	3	24958	3	31749	3	47075	3	60217	3
R16	11531	2	17040	1	20711	2	26042	2	38881	2	47729	1
R17	13656	3	19101	2	22994	2	29773	3	44323	3	55934	2
R18	10733	1	16011	1	18997	1	23241	1	35211	1	43513	1
R19	14902	3	21421	3	26227	3	31224	3	46790	3	60118	3
R20	11606	2	17210	2	21345	2	26458	2	40243	2	50109	2
R21	12332	2	18386	2	22433	2	28340	2	42350	2	52488	2
R22	12404	2	17798	2	21477	2	26700	2	40589	2	50293	2
R23	10275	1	15634	1	18741	1	23491	1	35403	1	42850	1
R24	12996	2	18714	2	23567	2	27672	2	41328	2	50895	2

Source: Calculated by the authors based on the State Statistics Service of Ukraine for 2009–2018.

Note: * Data are missing due to the impossibility of taking into account the results of part of the temporarily occupied territories in Donetsk and Luhansk regions

During the whole period, the lowest levels of P3 have been shown by the regions R2, R6, R16, R18, R23, which are ranked as the most depressed regions.

The dynamics of this indicator reflects the real economic situation in the regions, as well as the institutional conditions in which production is carried out, science and technology develop.

Ukraine is one of the countries with high income differentiation that has significantly increased in recent years.

The obtained data show that in this country it is the natural and climatic conditions, the level of reserves of natural resources, the development of industries that determine the available income and the level of material security of the population, as well as the differentiation of regions by this indicator.

The level of per capita income is low in the regions where the spheres of production and services are underdeveloped, there is no regional infrastructure, and no favorable conditions have been provided for the creation of new jobs and employment. Those are the causes for the assignment of these regions to the cluster groups with a low level of economic security.

According to the indicator P4, which reflects the Value of sold industrial production per capita, the cluster group of top-ranking regions (Table 5) has included R3 and R15 in the recent period, while R3 has been steadily in this cluster.

Table 5 Clustering of the regions by the level of P4 (Value of sold industrial production per capita), monetary units

	2009	cluster	2011	cluster	2013	cluster	2015	cluster	2017	cluster	2018	cluster
R1	8761	1	12795	1	15627	1	30446	3	45818	3	53284	2
R2	6316	1	10096	1	10474	1	18457	2	28132	2	32284	1
R3	33207	4	60236	4	66109	4	92509	4	136015	4	160411	4
R4	31544	4	60580	4	50791	3	40888	-	63475	-	*	-
R5	7841	1	11229	1	13000	1	20557	2	33415	2	41669	1
R6	4588	1	7010	1	7985	1	10977	1	17805	1	20526	1
R7	29338	3	45316	3	44200	3	76837	4	114610	4	129045	3
R8	8084	1	17438	2	15928	1	24633	2	35452	2	54721	2
R9	17703	2	26342	2	32366	2	42083	3	64368	3	81223	2
R10	7626	1	11976	1	18487	1	23616	2	30931	2	35543	1
R11	25187	3	42937	3	32443	2	10391	-	11289	*	*	-
R12	8504	1	12736	1	13640	1	22659	2	36155	2	43797	1
R13	14190	2	18565	2	19373	2	30061	3	46981	3	52944	2
R14	10989	2	11339	1	12444	1	22231	2	28315	2	30974	1
R15	26080	3	49154	3	49015	3	77258	4	136723	4	151966	4
R16	7802	1	13120	1	13552	1	23103	2	31591	2	34817	1
R17	10549	2	20335	2	21143	2	33006	3	39247	2	48619	1
R18	4738	1	7538	1	7570	1	11421	1	20607	1	23729	1
R19	16110	2	23134	2	28538	2	41240	3	68561	3	82389	2
R20	7388	1	10075	1	10146	1	16070	1	26856	2	29579	1
R21	7577	1	11368	1	13430	1	20796	2	31520	2	34120	1
R22	13873	2	22502	2	23531	2	38410	3	56282	3	65541	2
R23	3324	1	4334	1	4513	1	7493	1	12651	1	17551	1
R24	9441	1	13962	1	17527	1	26415	2	46436	3	44118	1

Source: Calculated by the authors based on the State Statistics Service of Ukraine for 2009–2018.

Note: * Data are missing due to the impossibility of taking into account the results of part of the temporarily occupied territories in Donetsk and Luhansk regions

The results of clustering indicate a decrease in the number of depressed regions by the level of P4 in 2015 and 2017 and a 2018 increase in their number to fifteen, including R2, R5, R6, R10, R12, R14 R16, R17, R18, R20, R21, R23, and R24. Accordingly, the number of regions with an average level of economic security in terms of P4 has decreased.

The obtained results indicate a significant polarization between the regions in terms of industrial potential.

The results of clustering by the indicator P5 are presented in Table 6.

In the last period, the number of low-ranking regions by the indicator P5 has significantly increased (from 3 to 16), and there is only one top-ranking region R9.

Table 6 Clustering of the regions by the level of P5 (Capital Investment per capita), monetary units

	2009	cluster	2011	cluster	2013	cluster	2015	cluster	2017	cluster	2018	cluster
R1	1636	1	3427	2	3769	2	4619	2	7425	2	11279	2
R2	2315	2	2118	1	3169	1	5946	3	6741	2	8403	1
R3	3964	4	5451	3	6469	3	7957	3	13277	4	18806	3
R4	2910	3	4906	3	6423	3	1946		4119	*	*	-
R5	1789	1	2985	2	2376	1	3206	1	6254	2	7130	1
R6	1526	1	2319	1	2148	1	3018	1	4451	1	5968	1
R7	2539	2	3349	2	3829	2	4448	2	9227	3	9204	1
R8	2463	2	2609	1	3473	2	6945	3	7042	2	6845	1
R9	5808	4	8956	4	11997	4	14086	4	19666	4	23022	4
R10	2751	3	4489	3	3240	1	4213	2	7634	2	7614	1
R11	1903	1	2684	1	5090	2	952	-	1522	-	*	-
R12	2628	2	4487	3	3861	2	5288	2	9527	3	11499	2
R13	3363	3	3480	2	4279	2	5181	2	9813	3	8929	1
R14	4182	4	3392	2	4966	2	4184	2	9358	3	9999	2
R15	5135	4	6905	4	6515	3	5768	3	11246	3	13282	2
R16	2345	2	2426	1	2416	1	3701	1	5256	1	6221	1
R17	1877	1	2430	1	2383	1	3324	1	6305	2	7120	1
R18	1286	1	2129	1	2795	1	3566	1	6842	2	8031	1
R19	2997	3	3902	2	3398	1	4120	2	7201	2	8821	1
R20	1921	1	2585	1	1958	1	2918	1	7068	2	8578	1
R21	2624	2	3030	2	2754	1	5253	2	8239	2	8935	1
R22	2316	2	2349	1	2698	1	3620	1	6637	2	9201	1
R23	2875	3	2430	1	2532	1	3077	1	3309	1	4091	1
R24	1442	1	2297	1	2718	1	3349	1	7254	2	8948	1

Source: Calculated by the authors based on the State Statistics Service of Ukraine for 2009–2018.

Note: * Data are missing due to the impossibility of taking into account the results of part of the temporarily occupied territories in Donetsk and Luhansk regions

The number of regions with average and above-average indicators of investment activity has also decreased. Declining investment activity is one of the reasons for the polarization of the regions in this country and the growth of economic threats.

Clustering by all the indicators provided for obtaining the following classification of the regions, presented in

Table 7. In 2018, compared to 2009, the number of depressed regions decreased to six (R2, R6, R8, R16, R18, R23), at the same time the number of top-ranking regions increased (R3, R7, R15).

The group of regions with average indicators includes 12 regions: R1, R5, R10, R12, R13, R14, R17, R19, R20, R21, R22, and R24. R9 has higher than average values. Luhansk and

Donetsk oblasts were not included in the regions analyzed in 2017-2018, as statistical information does not reflect the real situation in these regions.

The obtained results of the express assessment of economic security in the regions of Ukraine lead to the conclusion about the need for effective legal regulation in this sphere by state and regional authorities. The authorities should focus on the formation of a favorable institutional environment in the depressed regions, as well as on the formation of united cluster groups of regions, which will increase the level of economic security in each of the regions participating in such a cluster association. In this regard, we propose to take the following measures in the sphere of legal regulation of economic security in Ukraine.

Table 7 Clustering of the regions by the five indicators

cluster	2009	2013	2017	2018
1	R1, R5, R6, R16, R17, R18, R22, R24	R1, R2, R5, R6, R10, R16, R18, R20, R21, R22, R23, R24	R6, R8, R24	R2, R6, R8, R16, R18, R23
2	R2, R8, R10, R,12 R13, R14, R20, R21, R23	R8, R11, R12, R13, R14, R17, R19	R2, R5, R10, R16, R18, R20, R24	R1, R5, R10, R12, R13, R14, R17, R19, R20, R21, R22, R24
3	R4, R7, R11, R,19	R4, R7, R9, R15	R1, R12, R13, R14, R17, R19, R21, R22	R9
4	R3, R9, R15	R3	R3, R7, R9, R15	R3, R7, R15

Calculated by the authors

State support for the development of regions in Ukraine should include measures to form a legal and informational basis for maintaining the economic security of regions through the formation of their cluster groups, which includes the following measures:

- The Ministry of Economic Development and Trade of Ukraine should finalize and submit to the Cabinet of Ministers of Ukraine "Concept of Creating Clusters in Ukraine", and on its basis to propose a "Program for the Creation of Regional Clusters in Ukraine";
- Cabinet of Ministers of Ukraine and the State Agency for e-Government of Ukraine should stimulate the development and implementation of an official Internet agency representation, which will inform about the existing cluster groups in the regions and provide legal support to the regions that are forming the core of the cluster group at the level of central and regional government bodies;
- The Cabinet of Ministers of Ukraine, in order to study the prospects for creating cluster networks in the regions of Ukraine, should assemble an interdepartmental working group for working out a policy for the development of regional clusters in Ukraine with the involvement of leading Ukrainian and foreign experts; this will make it possible to conduct research and identify the most promising existing and potential clusters and to provide them with financial and organizational support from the state, by organizing a competition and selecting the best innovative projects for implementation;
- The National Academy of Sciences, with the support of the Ministry of Economic Development and Trade of Ukraine, should ensure the formation of a database on existing projects for the creation of regional clusters requiring investment and state support, which will result in revival in the field of the cluster formation;
- The State Agency for Electronic Government of Ukraine and the Ukrainian Chamber of Commerce and Industry should popularize the advantages of cluster interaction between the regions by conducting educational events for the regions, inform foreign partners about the prospects and benefits of cooperation with Ukrainian cluster networks, and cover the functioning of national clusters in the media.

In addition to the legal support of the development of regional clusters in Ukraine, it is advisable to introduce subject-institutional support of regional clustering processes, which provides for close cooperation with government officials (at all levels), business, professional,

public and research organizations in order to identify, agree, advocate and coordinate of interests of the participants in the clustering process. Achieving this goal is possible under the conditions of forming an independent structural unit within the Ministry of Economic Development and Trade of Ukraine, which should concentrate the responsibility and authority for the implementation of cluster policy; monitor the use and allocation of organizational and financial resources; conduct benchmarking research; control the implementation of pilot projects for the creation of clusters; monitor, assess and promptly adjust the cluster policy.

4. Conclusions

The scientific approach to assessing the economic security of the regions on the basis of cluster analysis enabled conducting its express analysis on the example of the regions of Ukraine, identifying the groups of regions with relatively equal and different levels of socio-economic development, determining the place and socio-economic status of each individual region and the management weaknesses and strengths in this sphere. A significant difference in the indicators P3, P4, P5 has been found between the leaders and outsiders, which indicates differentiation in the development of these regions and determines a high (low) level of economic security both in these regions and in the country as a whole.

The proposed approach to express assessment of economic security of the regions allows quick diagnosing and forming a general idea of the socio-economic status of the regions and the effectiveness of state and regional governance. This is the basis for threat management and developing business strategies at the regional level, creating favorable conditions for production development, increasing investment activity, income and employment, eliminating differentiation between leading and outsider regions, responding promptly to internal and external changes in the environment.

The proposed measures in the field of legal regulation of economic security of regions are aimed at improving the socio-economic situation of the depressed regions of Ukraine and using the advantages of leading regions to solve the problem of differentiation of the regions by Gross regional product, income and employment per capita, industrial production and fixed capital investment. This is possible on the basis of uniting the regions into regional cluster groups, the formation of the appropriate legal and information basis by the state, as well as direct support for such an initiative by state and local governments.

Prospects for further research in this direction may be the use of fuzzy logic methods and the construction of an integral index of economic security of the region, which will be the basis for the formation of a comprehensive approach to assessing economic security at the meso level.

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