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Modeling the anti-crisis management of territories under the conditions of decentralisation. A case study of Ukraine

Introduction

Under the conditions of uncertainty and processes of crisis that have been taking place in Ukraine since 1991, the government changed the direction of the country's development and launched new reforms in 2014. The emphasis in the reforms was laid on decentralisation of power as a component of the anti-crisis management. In this regard, the participation of citizens in the development and implementation of an effective model of business decision-making has become extremely important.

Decentralisation in Ukraine (in the legislative aspect) began in 1997 (Law of Ukraine "On Local Self-Government in Ukraine", 1997). However, this process has only begun to intensify in the past few years (Law of Ukraine On Cooperation of Territorial Communities, 2014).

Under the conditions of decentralisation, there are improvements visible on the level of management due to the transfer of rights and powers from central to local authorities. At the same time, the decentralisation reform determines the development prospects based on the use of available resources and identification of local needs. These actions are aimed at the withdrawal of the country from crisis by the activation

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of the populations in the regions. Decentralisation is a process of redistributing functions, powers, people or things between the governing bodies. The reform should ensure the stable and non-destructive activity of economic actors in the State (Stepaniuk, 2017).

There are numerous works by Ukrainian and foreign scholars, including economists, devoted to the theoretical and methodological aspects of anti-crisis management. They investigate the problems of crisis/anti-crisis management in the context of national security (Molek et al., 2011; Piwowarski, Rozwadowski, 2016; Wyligała, 2010). Others emphasise the management of organisations under crisis conditions (Averianov, 2002; Huczek, 2015; Lihonenko, 2004; Strzemecki, 2015; Walecka, Zakrzewska-Bielawska, 2009). Some in particular introduce definitions of anti-crisis management and also anticipate the dangers of crisis (Averianov, 2002; Lihonenko, 2004). They analyse the symptoms of crisis and the measures taken to reduce its negative effects. Some scholars concentrate their attention on the prompt identification of signs marking a crisis situation and the creation of appropriate prerequisites for its timely overcoming (Malyi et al., 2017; Pokataieva et al., 2017). The definitions and approaches are more specific with regard to the level of enterprises, while the territorial aspect remains unnoticed. There are numerous analogues of anti-crisis management in the world; however, the specificity of conditions prevailing in Ukraine make these approaches ineffective.

A special condition for resolving a crisis and the democratisation of state power and society is decentralised governance. An important argument for decentralising reforms is improvements in the efficiency of both central and local government. Such actions create favourable conditions for economic and social development. Tiebout (1956), an American researcher, emphasised the idea that the decentralised organization of production, work and services meet the needs of citizens in a more effective way than centralised planning does. Most modern scholars have tried to substantiate the effectiveness of decentralisation for the development of a country from the economic point of view. They concluded that decentralisation has a positive effect on the State's macroeconomic stability. In particular, Yifmaz (1999) hypothesised in 1999 that decentralisation has a positive impact on increasing the economic growth of any state: either federal or unitary. However, this hypothesis is not always ideal for countries in transition, where the impact of decentralisation is less significant. Attempts have been made to explain this situation (Brueckner, 2000; Zhang, 1998). Working independently,the authors suggest that all the positive effects of the decentralisation processes are offset by phenomena typical for states of this type, such as corruption and tax evasion (Izha, 2013).

The present-day features of anti-crisis management of the economy and related complications make it necessary to study the approaches to forecasting its consequences, taking the decentralisation reform into account. In this case, enhancing the effectiveness of anti-crisis management will be possible through the development of better models and forecasts.

Calculations related to the implementation of decentralisation processes in the regions show how important it is to generate local community budgets for territorial development. Simultaneously, it significantly influences the stabilisation of the socio-economic situation of the territories and reduces the likelihood of crisis manifestations.

Object, aim and research methods

The object was to investigate the process of modelling anti-crisis economy management. Anti-crisis economy management of territorial entities under the conditions of decentralisation gives the opportunity (under an increasing crisis) to restore effective operation to each territorial entity of the microeconomic system. The basis for such restoration is the mechanism of self-organisation and support for a stable internal condition and dynamic external environment.

A number of weakly formalised tasks that arise in the process of implementing anti-crisis management necessitate the use of model support for the decision-making processes in the development of programs and the implementation of mechanisms and measures for the anti-crisis strategy.

In the current conditions of a protracted crisis, only a reform of the national economy can lead to success. In its turn, decentralisation (i.e., the division of the country into united territorial communities) is the most important component of the reform. Today, this process in Ukraine is at its initial stage. One of the most significant problems is the fact that the country lacks relevant experience, and therefore it is worth creating models that enable forecasts for different scenarios.

The aim of the study was to develop a method for modelling the anti-crisis management of territories under the conditions of decentralisation. To achieve this goal, the following tasks were set: to develop an algorithm for grouping objects according to the level of improvement of anti-crisis management in a decentralised environment; and to justify the cluster ranking methodology based on a taxonomic index.

In order to implement the tasks set out in the article, the methods of economic analysis, forecasting and development of anti-crisis programs were applied.

Research results

Decentralisation is a complex process that for Ukraine began a long time ago at the legislative level, while practical steps have been taken only in the last few years. Accordingly, crisis phenomena are observed in all regions of Ukraine. The differences are evident only in terms of the intensity of the manifestations.

Decentralisation of public authorities is the aim of the constitutional and administrative reforms in Ukraine.

The main principles for the financial empowerment of local authorities are laid down in Article 9 of the European Charter of Local Self-Government, which states that "local self-government bodies have the right, within the framework of national economic policy, to apply their own adequate financial resources, which they can freely dispose of within their powers" (European Charter of Local Self-Government, 2012). The financial resources from local governments are formed partly on the basis of local taxes and fees, the amount of which they have the authority to establish within the law. The Law of Ukraine stipulates that the independence of local budgets is guaranteed by their own fixed income as well as national income, fixed on a stable basis by law, along with the right to determine the direction of using the funds from the local budget independently, in accordance with the law "On Local Self-Government in Ukraine" (1997). One of the first legislative acts aimed at implementing decentralisation was the law "On Cooperation of Territorial Communities" (2014), which was followed by the development and adoption of a number of other legislative acts aimed at other areas. This included one of the most important for our research: "On Amendments to the Tax Code of Ukraine and Certain Legislative Acts on Tax Reform" (2014). This set of legislative acts made it possible to implement the first stage of decentralisation – the formation of cost-effective and sustainable territorial communities.

Decentralisation is defined as a system that incorporates mechanisms, approaches, tools and processes, formed, implemented and realized in the course of government operation. That is why decentralisation of local governance implies: principles, ways and methods of management; forms of power organisation; functions related to division of powers and realization of rights; elements of the organisational structure of management.

Decentralisation is accompanied by the redistribution of functions between different levels of government for the benefit of regional and local governments. As a consequence, there are competent, financially self-sufficient, population-controlled centres of government and decision-making at the local level. Thus responsibility is dispersed, and risks arising from large-scale centralised decisions and actions are reduced.

The main functions of management are to implement the budget and regulate its distribution in accordance with the defined goals of socio-economic development. These functions are interrelated, since the future formation of the budget depends on the efficiency of allocating financial resources and using effective levers to stimulate certain areas of action. Budget decentralisation can lead to economic growth only by applying the mechanism of promoting self-sufficiency, the formation of financial and economic potential of sustainable development, the positive image of regions and territories, and the improvement of labour potential. In turn, the government

should only supplement (if needed) the financial resources of the region depending on the climatic conditions, resource potential, environmental problems, development prospects, etc.

Decentralisation is a factor in establishing fruitful relations between the central government and governmental bodies at the local level. The motivation for widespread decentralisation of power covers two aspects: political and economic. The first is a reaction to the central regulation of the activities that local authorities implement, while the second is a consequence of excessive central distribution of activities and the need for more efficient use of available resources.

The task of anti-crisis management is to identify and take into account the external and internal constraints that can be solved naturally or indirectly. Groups of restrictions remain in a certain ratio, which changes dynamically. This determines the change and probability of crisis phenomena emergence. The essence of crisis management is manifest in finding those approaches to the restrictions that can be regulated. For example, internal constraints can be alleviated by changing the managerial apparatus, its rotation, training, or by improving motivational approaches. It is possible to reduce the effect of external constraints by making appropriate changes to the regulatory and enforcement provisions.

The introduction of anti-crisis measures for economic management should be based on a certain complex of processes, techniques and methods. This is a matter of methods applied to study phenomena (objects, subjects), division of the object into its constituent parts; studying the data obtained from different parties; and identifying and analysing relationships between factors and outcomes. It is important to emphasize that the analysis should be carried out for both macro- and meso-level objects. Its goal is to determine the current situation and further research directions. The most common method of analysis is to identify the factors that affect the achievement of the goals set in the problem.

For example, let us consider a crisis situation at the level of the territorial community and search for ways to resolve it. First, it is necessary to identify those factors that may affect the final result (availability of development strategy, appropriate resource base, budgetary potential, qualified management capacity, etc.). Having modelled the dynamics of change in these indicators, one can determine the stage of development of the territory and suggest strategies to overcome the crisis.

Effective planning of the economic development of the territory requires a forecasting method, which should contain the accumulated management experience in terms of the national economy and current assumptions regarding the subsequent appearance of this object. As a result, the predicted model of the future can be used as a basis for further development and identification of the planning components. Predictions in management are based on the models of development of a managed object, which influence the effectiveness of the economic, social and environmental processes.

Note that in recent years, the forecasting methodology has been replenished with a number of effective methods of strategic analysis, new information technologies and programs, as well as technological products. These include two groups of methods (Bobrovska, 2011):

– methods and models used at the stage of creating the information-analytical base for analysis and diagnostics of the state of predicted objects and processes;
– methods and models of multidimensional estimates and multi-factor forecasting based on the data of interrelated dynamic series.

These methods supplement the possibilities of state planning and management. Today, forecasting the development of territorial communities and entities, where they are located, under the conditions of decentralised environment, is relatively new for Ukraine. That is why the scientific approach to state planning and management is a guarantee of effectiveness. The introduction of the modelled situations is planned to increase the socio-economic well-being of the population in the country.

Modern national and regional economies in Ukraine are developing under the influence of a large number of internal and external factors. At the same time, the manifestations of galloping inflation, military actions, changes in commodity pricing in domestic and foreign markets, and the instability of the national currency – all this deprives forecasts of their significance and increases uncertainty. As a result, forecasting economic development has lost its normative content. Therefore, the authorities, both national and regional, have begun to develop preliminary rather than regulatory forecasts. However, the lack of regulatory forecasting leads to a chaotic economic information policy in Ukraine.

Forecasts of economic, social and environmental development are a means of justifying the choice (by legislative and executive authorities as well as local governments) of a certain strategy and taking specific decisions on the regulation of the socio-economic processes in the regions. Along with this, in the context of establishing the forecasting of anti-crisis management under the conditions of decentralisation reforms, it is important to take into account specific features of all regions of the country. At the next stage, it is necessary to conduct analyses of the obtained results when applying scientific methods.

To study, analyse and develop proposals in terms of anti-crisis management, we suggest applying a cluster approach. To this end, the selected set of territorial entities can be divided into clusters through the selection of the most similar elements. Cluster analysis is a multidimensional statistical procedure which, based on the collection of information on the sampling of objects, allows them to be organized in relatively homogeneous groups using several characteristics simultaneously. This method is fully suitable for modelling the anti-crisis management of territories under the conditions of decentralisation, which simultaneously takes into account disparate indicators. For this purpose, relevant indicators that characterise a degree of similarity for all classification parameters are used (Nakonechnyi et al., 2009).

Methods of cluster analysis are divided into two groups: hierarchical and non-hierarchical (Katrenko, 2003). To solve the problems under consideration in this study, we suggest the use of the following methods of multidimensional classification: hierarchical agglomerative methods of cautering and the *k-means* method.

Hierarchical methods of clustering include two categories of algorithm. The first is known as agglomerative and starts with a single-element cluster, which combines two clusters to build a hierarchy of clusters "from the bottom up" (Yakymets, 2016). The second group (Divisive methods) is determined by the method of separation of a large macrocluster, which contains all the elements and is divided into two groups, with each of these also divided into two, etc. Thus the cluster hierarchy is generated from top to bottom. Hierarchical algorithms build a system of nested partitions, which means that a cluster tree is created at the output of the algorithm, complete with a root (all sample) and leaves (the smallest clusters). For comparison, non-hierarchical algorithms build only one breakdown of the objects into clusters.

The *k-means* method implies the implementation of grouping in the data. In *k*-sectioning the following sequence occurs:

1. Each cluster is represented as the centre of a cluster.
2. Based on the *k*-array of data, centroids are selected.
3. Until the convergence criterion is achieved, the following steps are taken in the cycle (Yakymets, 2016):

- allocation of *k*-clusters by assigning each point to the closest centroid;
- redefining of the centroids;
- the suggested algorithm can use different measures of distance, such as Manhattan and Euclidian distances.

The characteristics of the method are as follows:

- computational complexity takes into account the number of objects, the number of clusters and the number of iterations. The method is effective since the calculations produce a single result;
- clustering can be completed at the local optimum, so a high-quality result requires first initialisation;
- it is necessary to set the number of clusters in advance;
- sensitivity to "noisy" data and values that vary greatly;
- possibility of sole application to numerical data;
- there is no possibility to build clusters of a non-convex form.

Graphically, the algorithm for grouping territorial entities according to the level of improvement of anti-crisis management of the national economy of Ukraine under the conditions of decentralisation is given in Figure 1.

For conducting and approbation of the suggested method of cluster analysis, data from the State Statistics Service of Ukraine for 2017 were used.

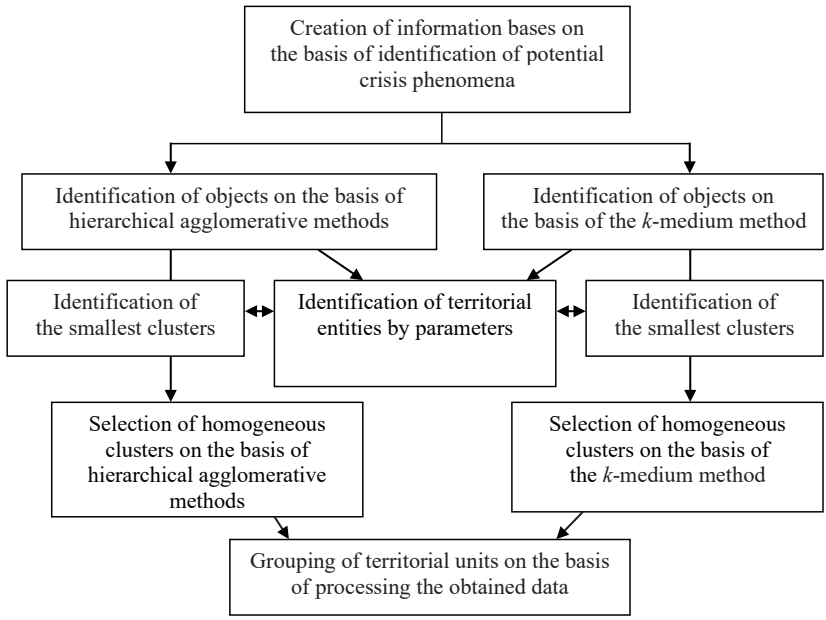


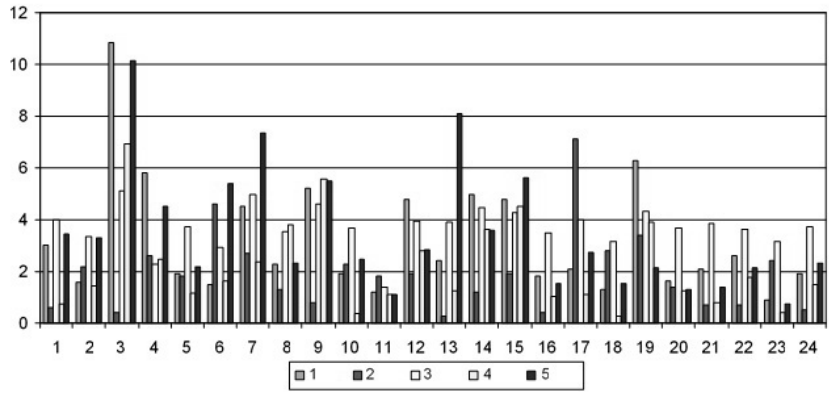
Figure 1. Algorithm for grouping objects according to the level of improvement of anti-crisis management in the national economy of Ukraine under the conditions of decentralisation

Source: own study.

The method involves choosing parameters for three components of the model: economic, social, and environmental.

The leading parameters of the economic component were selected (as a percentage of the total indicator in the regions of the country): gross regional product (Row 1); volume of disposed innovative products (Row 2); availability of income per person (Row 3); volume of raised investments (Row 4); volume of exported products (Row 5). Their values (along the ordinate axis) for the individual regions are given in Figure 2. Moreover, in the Figures 2, 3, and 4 for regions (without the Autonomous Republic of Crimea) the following numbers were assigned (axis of abscissas): 1. Vinnitsa, 2. Volyn, 3. Dnipropetrovsk, 4. Donetsk, 5. Zhytomyr, 6. Zakarpattia, 7. Zaporizhia, 8. Ivano-Frankivsk, 9. Kyiv, 10. Kirovograd, 11. Luhansk, 12. Lviv, 13. Mykolaiv, 14. Odesa, 15. Poltava, 16. Rivne, 17. Sumy, 18. Ternopil, 19. Kharkiv, 20. Kherson, 21. Khmelnitsky, 22. Cherkasy, 23. Chernivtsi, 24. Chernihiv.

The results of the parameter analysis indicate the availability of a general tendency to increase the value of most indicators in the industrialized regions (Dnipropetrovsk, Donetsk, Zaporizhia, Kyiv, Lviv, Mykolaiv, Kharkiv). The lowest economic indicators were recorded in the Luhansk, Rivne and Ternopil regions. This tendency is also observed in the territorial communities of the investigated areas. The main reasons for such a situation are economic crisis, inflation and military actions in eastern Ukraine.

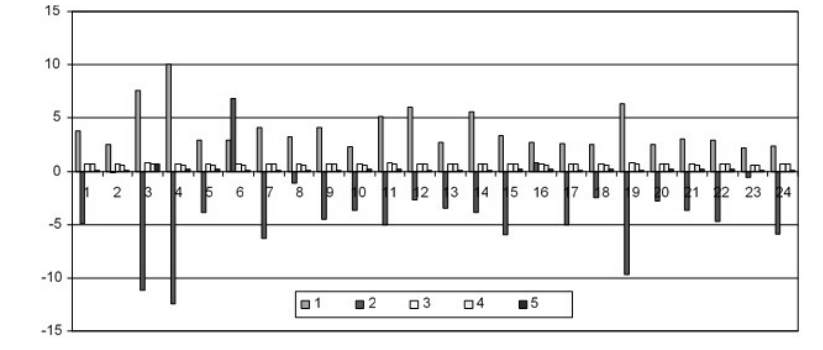


1 – gross regional product; 2 – volume of disposed innovative products; 3 – availability of income per person; 4 – volume of raised investments; 5 – volume of exported products

Figure 2. Selection of economic parameters for model construction

Source: own study based on (State Statistics Committee, 2018).

The leading parameters of the social component (as a percentage of the total indicator in the regions of the country) are: share of the available population (Row 1), natural increase (decrease) of the population (Row 2), level of economic activity of the able-bodied population (Row 3), employment rate (Row 4) and unemployment rate (Row 5). The analysis was carried out in all regions of Ukraine. The results of the parameters analysis indicate a general stability of the last three parameters in all regions, while natural growth is observed only in two regions (Zakarpattia, Rivne) (Figure 3).



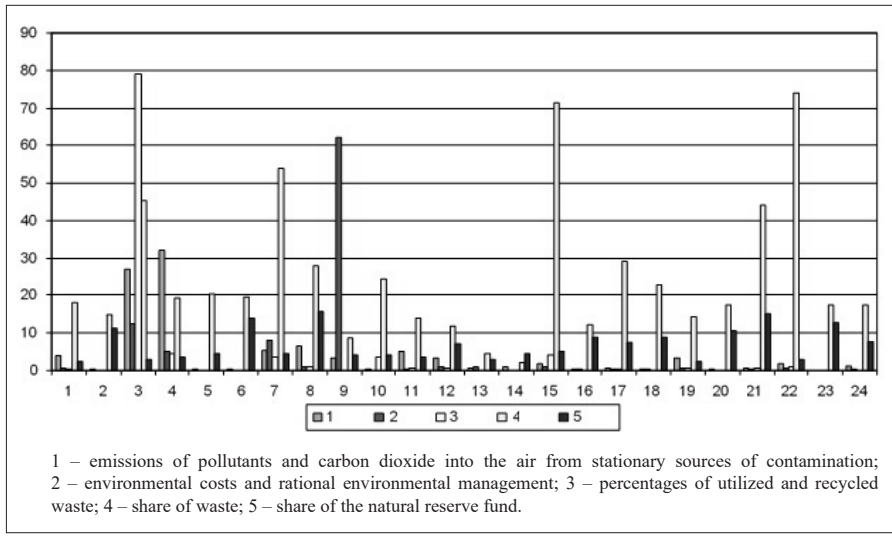
1 – share of the available population; 2 – natural increase (decrease) of the population; 3 – level of economic activity of the able-bodied population; 4 –employment rate; 5 – unemployment rate.

Figure 3. Selection of social parameters for model construction

Source: own study based on (State Statistics Committee, 2018).

The leading parameters of the **ecological component** were selected (as a percentage of the total indicator in the regions of the country) as follows: emissions of pollutants and carbon dioxide into the air from stationary sources of contamination (Row 1), environmental costs and rational environmental management (Row 2), percentages of utilized and recycled waste (Row 3), share of waste (Row 4) and share of the natural reserve fund (Row 5) (Figure 4).

The results of the parameter analysis indicate that the availability of a general tendency – in industrialized regions (Dnipropetrovsk, Zaporizhia, and Kyiv) a higher percentage of investments is aimed at environmental protection and waste processing – and the share of waste disposal is higher in non-industrial regions (Poltava, Khmelnytsky, Cherkasy), while the share of the natural reserve fund is distributed almost equally across all regions of the country.



1 – emissions of pollutants and carbon dioxide into the air from stationary sources of contamination; 2 – environmental costs and rational environmental management; 3 – percentages of utilized and recycled waste; 4 – share of waste; 5 – share of the natural reserve fund.

Figure 4. Selection of ecological parameters for model construction

Source: own study based on (State Statistics Committee, 2018).

The analysis results were obtained using the STATISTICA program, with the totality of areas under research divided into three groups of objects according to macroindicators, similar to the nature of development. For the beginning of the procedure, *k* random objects to be used as references or centres of clusters have to be set (Fiedosieiev et al., 2002).

To find the optimal configuration in the group, it is necessary to:

- compare the values of potential aggregate results of all cluster participants in all possible options;
- determine the reference configuration as most advantageous for all participants;
- choose the optimal composition of the cluster, focusing on the standard.

These problems can be solved by means of a taxonomic method (Euclidean distances). Its basis is formed with the selection of a standard and a comparison of the optimal parameters (coordinates) of its vector with the corresponding parameters of the vectors of all other objects studied (identification of Euclidean distances, according to which the object is ranked: the smallest distance corresponds to the highest point of the object). The principle of this technique is to present all the statistical data according to the selected criteria (indicators) in the form of a matrix, where a single line is a vector of a particular object, the coordinates of which are the values of criteria (indicators).

Since the studied indicators have different natures and different meanings, some normalization of the matrix elements is needed.

For the formation of the standard, maximum values are selected among the matrix elements. The reference point is E_0 with the coordinates K_{01}, K_{02}, K_{03}, K_{04}, K_{05}, obtained as follows (Fiedosieiev et al., 2002):

$$K_{0j} = \max k_{ij}, j = \overline{1.5}$$

where: k_{ij} – coordinates of the studied configuration.

Since matrix K consists of normalized values, each column is a vector, the coordinates of which in the sum are equal to zero. A comparison of possible cluster configurations with indicators of the reference configuration was carried out by means of identifying the Euclidean distance according to the formula (Horitsyna et al., 2010):

$$C_i = \sqrt{\sum_{j=1}^{n} (k_{ij} - k_{oj})^2},$$

where: k_{0j}, k_{ij} – normalized coordinates according to the reference and study configurations.

The average distance for the entire totality is determined according to the formula:

$$C_0 = \frac{1}{m} \sum_{i=1}^{m} C_i$$

where: m – numerical observation moment.

Deviations in the whole totality are determined according to the formula:

$$\sigma = \sqrt{\frac{1}{m} \sum_{j=1}^{m} (C_j - C_0)^2}$$

where: C_0, C_j – normalized coordinates according to the reference and study configurations.

The taxonomic index of the studied configuration is calculated according to the formula:

$$d_j = \frac{1 - C_j}{C}$$

where: $C=C_0+2\sigma_0$
σ_0 is a standard, and 0 in the calculations is substituted with the values of j.
σ_j – deviation of j-th indicator,
j = 1, 2, 3, 4 – number of the indicator

As a result, the closer the value of the taxonomic value is to 1, the more perfect the configuration is and the more likely it is that the use of available resources is effective.

According to the calculations, which formed the basis of the matrix, the allocation of five clusters on the territory of Ukraine is substantiated.

To identify the crisis state of territories (under the conditions of decentralisation), we suggest supplementing the model with risk factor K_r, which characterises the ratio of probability magnitude of the maximum possible damage (Z_{max}) to the normative value of the socio-ecological and economic components of the territories (K_{0j}). The risk factor is calculated according to the formula:

$$K_r = \frac{Z_{max}}{K_{0j}} 100\%$$

The obtained values of the risk factor can be assessed according to the scale:
up to 10% – favourable condition (i.e. lowest risk);
from 10% to 30% – optimal condition;
from 31% to 69% – alarm condition;
from 70% – crisis situation (i.e. highest risk).

Simultaneously, it is appropriate to take into account the overall decentralisation factor in decision-making (K_d), which allows assessing the degree of decentralization in a particular management system. It is calculated according to the formula (Antoniuk, 2018a):

$$K_d = \frac{r_i}{R_i} 100\%$$

where:
r_i – number of decisions taken at the lower levels of the hierarchy in the *i*-th period;
R_i – total number of decisions taken in the *i*-th period.

The scale to determine the impact of the calculated decentralisation factor:
0.0–0.1 – minimum degree;
0.1–0.3 – insignificant degree;

0.3–0.5 – medium degree;
0.5–0.8 – significant degree;
0.8–1.0 – high degree.

The closer the coefficient is to 1, the higher the degree of decentralisation. However, considering merely the number of solutions will be inadequate because it disregards the importance of decisions taken at the lower levels of management and the degree of their independence; therefore, the definition of this indicator is of a general nature. The starting data for determining this ratio were the data obtained after the assessment of the financial capacity of the united territorial communities operating in the regions of the country, based on the results of monitoring how local budget targets for 2017were met. The assessment was carried out according to the indicators that reflect: own income per capita of one inhabitant; level of subsidisation of budgets (share of basic/reverse subsidies in income); specific weight of expenditures on management body maintenance in the community's own resources (without transfers from the state budget); and capital expenditures per inhabitant (Financial Assessment of 366 UTC, 2018).

According to the results of the study, we suggest using a model for identifying the crisis state of the territories under the conditions of decentralisation which takes into account: resource potential; social, ecological and economic components of the development of territories; risk coefficient of crisis; and general decentralization factor. The final model is as follows:

$$N = E_s^{\gamma} + d_i + K_r + K_d$$

where:
N – indicator of detecting the crisis state of the territories under the conditions of decentralisation;
E^{γ}_s – capacity utilisation rate;
d_i – taxonomic index of the studied cluster configuration;
K_r – risk coefficient;
K_d – general factor of decentralisation in decision-making.

Accordingly, the aggregate indicator (efficiency norm) of potential use (E^{γ}_s) is defined as follows (Antoniuk, 2018):

$$E_s^{\gamma} = \frac{P_p^{\gamma}}{V_s^{\gamma}} = E_n \cdot d_n + E_l \cdot d_l + E_k \cdot d_k$$

where:
d_n, d_l, d_k – ratios of natural, labour and stock potentials accordingly in aggregate potential;
E_n, E_l, E_k – potential of natural resources, potential of labour resources and potential of the basic funds.

Indicator *N* can assume the favourable, optimal, small, minimal and lowest value of the decentralisation degree. Depending on the obtained value of the indicator, a different approach is used to develop and implement the strategies of territorial development.

It is not complicated to discern that the norm of effectiveness for each territorial formation will have a differentiated character due to structural differences in the component composition of the total potential of the territory. This allows the theoretically correct justification of the cluster differentiation sources of the costs of social labour and methodological conditions for conducting cluster comparisons. The latter can be produced by bringing the component of assessment to a single structural basis, which can be formed by the structure of the overall potential of the state national economy.

On the basis of the constructed model, the value of index N was calculated, which made it possible to determine the rating of regions and suggest their division into five clusters (Table 1).

As a result of the cluster ranking (according to the level of factor macroeconomic indicators and measured coefficients), the administrative regions of Cluster I can be determined as the closest to the standard. The index of detection of crisis situations in these territories is the lowest. Cluster II has eight administrative regions, while Cluster III has four. Clusters IV and V have five regions each. All clusters in the country are characterised by a minimal and insignificant degree of decentralisation, which indicates slow movement in this direction.

Calculating the existing potential of the administrative regions of a country can be made and the priorities of their long-term development as well as probability of crises under the conditions of decentralisation determined to indicate their further growth and development. In focusing on the original values, we have obtained likely insights into the main tendencies in future variations.

Table 1. Cluster ranking based on taxonomic indicator

Clusters	Regions	Estimated values				Indicator for detecting the crisis state of the territories under the conditions of decentralisation (N)
		E^{γ}_{s}	d_i	K_r	K_d	
1	*2*	*3*	*4*	*5*	*6*	*7*
V	Luhansk*	0.02	0.1	0.02	0.02	0.16
	Rivne	0.03	0.1	0.02	0.02	0.17
	Ternopil	0.04	0.1	0.02	0.02	0.18
	Khmelnitsky	0.05	0.1	0.02	0.02	0.19
	Chernivtsi	0.08	0.1	0.02	0.02	0.22
IV	Kirovograd	0.06	0.1	0.02	0.05	0.23
	Kherson	0.07	0.1	0.02	0.05	0.24
	Cherkasy	0.07	0.1	0.04	0.06	0.27
	Chernihiv	0.09	0.1	0.07	0.09	0.35

1	*2*	*3*	*4*	*5*	*6*	*7*
III	Volyn	0.03	0.2	0.07	0.06	0.36
	Zhytomyr	0.06	0.2	0.08	0.08	0.42
	Ivano-Frankivsk	0.08	0.2	0.10	0.10	0.48
	Mykolaiv	0.13	0.2	0.12	0.13	0.58
II	Donetsk*	0.14	0.3	0.11	0.12	0.67
	Zakarpattia	0.16	0.3	0.14	0.14	0.74
	Kyiv	0.16	0.3	0.15	0.15	0.76
	Lviv	0.17	0.3	0.15	0.16	0.78
	Odesa	0.16	0.3	0.16	0.17	0.79
	Poltava	0.17	0.3	0.16	0.17	0.80
	Sumy	0.16	0.3	0.17	0.17	0.80
	Kharkiv	0.18	0.3	0.17	0.17	0.82
I	Zaporizhia	0.18	0.4	0.14	0.12	0.84
	Dnipropetrovsk	0.20	0.4	0.19	0.17	0.96

Note: * – without extracted territories

Source: own study.

Conclusions

We believe that the increase in the budget resources of the regions will be facilitated by improvements in anti-crisis management, both at the central and the local levels.

Accordingly, decentralisation has a major impact on the development of democracy and the implementation of changes in society, transition of governance based on the initiative and responsibility of the community as well as that of the individual, which is a matter of special importance under a crisis situation. We propose a method of crisis management in Ukraine based on decentralisation.

In the present study, we developed an algorithm for grouping objects according to the level of improvement of anti-crisis management in the national economy of Ukraine under the conditions of decentralisation. Unlike the existing algorithms, it takes into account the positive effect of implemented anti-crisis actions. It certifies that taking into account social, environmental and economic parameters significantly influences the result of grouping objects and determines the direction of anti-crisis measures. In addition, we substantiated the cluster ranking methodology based on a taxonomic indicator, which helps to identify the most problematic areas in the country. Unlike the existing techniques, this one takes into account the indicator of detecting crisis situations in the territories and allows an analysis of the social, ecological and economic conditions of the conjoint territorial object. In order to

identify the crisis state of territories under the conditions of decentralisation, we introduced a risk factor and suggested its gradation.

The research allows the differentiating of approaches to the creation of development plans for territorial systems of various types, allocated in accordance with revealing the crisis state of the territories. The application of the suggested methodology should allow them to maintain a long-term development on the basis of sustainability under the conditions of decentralisation.

The present study may be of interest to numerous countries in the world that face aspects of crisis phenomena or strive to determine the level of social, ecological and economic development of a certain territory. Based on the suggested methodology, it is possible to design prospective development plans for the territories in any country.

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Summary

The article examines the process of modelling the anti-crisis management of an economy under the conditions of decentralisation using the example of Ukraine. Under the conditions of economic reform and aggravating crisis phenomena, a task of crucial importance is developing the prediction

capability related to the effectiveness of the scheduled actions. The most problematic area in crisis management is the development of an effective model that takes into account the participation of citizens in the process of business decision-making.

One of the possible solutions to this problem is to model situations to overcome the crisis, and to study the territories (regions of the country) in terms of their socio-ecological and economic status. The study applied the following methods: study of phenomena (objects, subjects); division of the territory of Ukraine into parts according to aggregate indicators; research into the various aspects of territorial objects; and the identification and analysis of interrelations between the factors and results.

On the basis of the developed approach and results of the study, a model is suggested for identifying the crisis status of territories in a decentralised environment; the latter takes the following into account: availability of resource and labour potential; social, ecological and economic components of the development of territories; risk factor for the advent of crisis; and the overall coefficient of decentralisation.

The introduction of an algorithm was suggested for grouping objects, which takes into account the level of improvement in anti-crisis management under the conditions of a decentralised environment. The use of the cluster ranking methodology, which, unlike the existing ones, includes calculations based on taxonomic metrics, was rationalized. The research allowed the introduction of a differentiation approach to creating development plans for the various types of territorial systems included in the clusters. The division was made in accordance with the crisis situation in the territories to allow development on the basis of sustainability in the context of introducing decentralisation.

Keywords: modelling of anti-crisis management, crisis situation of territories, decentralisation in Ukraine, territorial entities.

Modelowanie kryzysowego zarządzania terytoriami w warunkach decentralizacji: na przykładzie Ukrainy

Streszczenie

W artykule przeanalizowano proces modelowania zarządzania kryzysowego gospodarką w warunkach decentralizacji, na przykładzie Ukrainy. W warunkach reform gospodarczych i rozprzestrzeniania zjawisk kryzysowych, istotnym zadaniem jest umiejętność przewidywania skuteczności zaplanowanych działań. Najbardziej problematyczne w zarządzaniu kryzysowym jest opracowanie skutecznego modelu uwzględniającego udział obywateli w procesie podejmowania decyzji ekonomicznych. Jednym z możliwych rozwiązań tego problemu jest modelowanie sytuacji w celu przezwyciężenia kryzysu i zbadanie terytoriów (regionów kraju) pod względem ich stanu społeczno-ekologiczno-gospodarczego. W trakcie badania wykorzystano następujące metody: badanie zjawisk (przedmiotów, obiektów); podział terytorium Ukrainy na podstawie zestawu wybranych wskaźników; badanie zróżnicowania obiektu terytorialnego; identyfikacja i analiza relacji między czynnikami a wynikami.

W oparciu o opracowane podejście i wyniki badania zaproponowano model umożliwiający identyfikację sytuacji kryzysowej terytoriów w warunkach decentralizacji, który bierze pod uwagę: dostępność zasobów i potencjał zasobów pracy; społeczne, ekologiczne i ekonomiczne elementy rozwoju terytoriów; współczynnik ryzyka kryzysu; ogólny współczynnik decentralizacji.

Zaproponowano algorytm grupowania obiektów, który uwzględnia poziom poprawy zarządzania kryzysowego w warunkach decentralizacji. Uzasadniono wykorzystanie metody rankingu klastrów, która wykorzystuje indeks taksonomiczny. Przeprowadzone badania umożliwiły wska-

zanie różnych podejść do tworzenia planów rozwoju różnych typów systemów terytorialnych wchodzących w skład klastrów. Podział został przeprowadzony zgodnie z sytuacją kryzysową poszczególnych terytoriów, co zapewniłoby ich zrównoważony rozwój w warunkach wprowadzenia decentralizacji.

Słowa kluczowe: modelowanie zarządzania kryzysowego, stan kryzysowy terytoriów, decentralizacja na Ukrainie, jednostki terytorialne.

JEL: H12, R12, R15.