UDC 332.13: 330.13

https://doi.org/10.33271/nvngu/2020-1/135

T. Beridze[1], Cand. Sc. (Tech.), Assoc. Prof.,
orcid.org/0000-0003-2509-3242,
N. Lokhman[2], Cand. Sc. (Econ.), Assoc. Prof.,
orcid.org/0000-0002-0116-2525,
O. Bondarenko[3], Cand. Sc. (Econ.), Assoc. Prof.,
orcid.org/0000-0002-0387-3486,
A. Buhra[4], Cand. Sc. (Pedag.),
orcid.org/0000-0003-3978-3404

1 – Kryvyi Rih Faculty of Zaporizhzhia National University, Kryvyi Rih, Ukraine, email: beridzet2016@gmail.com
2 – Donetsk National University of Economy and Trade named after Mykhailo Tuga Baranovsky, Kryvyi Rih, Ukraine, email: aleks.lokhman@gmail.com
3 – Kryvyi Rih Economic Institute of Kyiv National Economic University Named after Vadym Hetman, Kryvyi Rih, Ukraine, email: bondarenko0708@gmail.com
4 – Kryvyi Rih National University, Kryvyi Rih, Ukraine, email: alina.bugra@gmail.com

HARMONIZATION OF RESULTS OF MODELING PRODUCTION SYSTEMS OF UKRAINE'S REGIONS

Purpose. Establishing systemic interregional manufacturing relations, analysis of corporate characteristics of production systems, formation of applied scientific and methodological support.

Methodology. The tools of economic and mathematical modeling for the purpose of analyzing and assessing characteristics of the main regional indicators are formed. Economic and social indicators that are relevant for the regional distribution of resources are analyzed. At the level of individual production systems, structural transformation aims to increase the efficiency of concentration of resources in subdivisions with higher returns. A prerequisite for the formation of rational management decisions is a thorough, qualitative analysis of complex production systems, availability of resources and their distribution.

Findings. Systemic interregional relations, corporate characteristics of production systems are determined, which allowed identifying clusters according to the determined indicators and proving rationality of application of the models, determining efficiency of regional allocation of resources.

Originality. Innovative approach to the formation of cluster and index modeling harmonization techniques allowed appropriate analysis for effective managerial recommendations.

Practical value. The practical experience of using the proposed methodology proved its effectiveness in making rational management decisions in order to ensure economic growth of the regions. The clusters are formed and index models are created which are the basis for further research on developing multi-factor regression models and forecasting models.

Keywords: *modeling, region, production system, indices, resources, cluster*

Introduction. One of prerequisites of efficient economic growth is enhancement of management of production systems, building of the rational structure of interconnections between regions. To provide efficient functioning and development of the regional management mechanism, it is expedient to use the adequate system of models that considers complexity and high dynamism of production systems and ensure possibility of relevant studies. More intensive processes of market transformations in Ukraine increase dependency of their effectiveness on proportions of resource distribution in regions, dynamics of their long-term equilibrium.

Production system models are the information image of real objects. Therefore, their analysis is closely connected with management and can be treated as a complex of operations, procedures of data transformation to ensure goal achievement.

Harmonization of modeled results will enable determining effective regional distribution of resources, conducting forecasting analysis of resource provision and providing recommendations on rational managerial decisions.

Literature review. Theoretical and methodological support of modeling and forecasting production systems in conditions of transformation is dealt with in works by V. Dzenis, O. Dzenis [1], T. Vasyltsiv [2], A. Tkachenko [3], I. Moiseienko [4] and others who study issues of economic and mathematical modeling of certain aspects of the financial and economic potential of an industry, determine stages of choosing and forming the strategy of financing development of an enterprise.

Dmytryshyn B. and Hamalii V. [5] suggest conceptual approaches to the complex of economic and mathematical models of evaluation and analysis of national and regional economic systems productivity on the basis of input-output models. Studying cause-and-effect relations and regulations of socio-economic processes, O. Cherevko applies the multidimensional correlation-regression analysis of territorial differentiation of regions' investment climate levels which enables representing each region through a range of parameters interpreted as coordinates of a point in the multidimensional space [6].

Yelisieieva's O. research deals with modeling management of socio-economic systems [7] where conceptual provisions of managing development of socio-economic systems on the basis of integral mechanisms, managerial algorithms, models and technologies are presented. L. Burkova's [8] recommendations on theoretical and methodological provisions, tools and practical guidelines for measuring enterprises' performance form the basis for building relevant models.

Development of production systems is undoubtedly a foundation for socio-economic development of the national

economy and therefore should be based on the ability to sustain internal and external challenges.

Unsolved aspects of the problem. Changeability of competitive strengths of an enterprise requires relevant correction of its management system, firstly through implementation of corporate analysis of production systems. Introduction of principles of sustainable development of regions, formation of internal and interregional market-based economic relations are increasingly gaining topicality. Gaps in studies on the problem condition significance and necessity of further research. Top priority should be given to modeling production systems on the basis of applying formalized methods in order to further forecast trends of regions' socio-economic development.

Purpose. The article is aimed at studying systemic interregional connections and corporate characteristics of production systems, forming applied scientific and methodological tools for economic and mathematical modeling for analyzing, measuring and forecasting characteristics of the main regional indicators.

Results. The integrated evaluation of the regions' production systems is a rather complicated task and plays an important role in ensuring their sustainable economic development and should be performed on the basis of modern economic and mathematical models. One of the major principles of managing production systems is the principle of optimality.

Due to the fact that complexity of economics rules out complete formalization of such systems, within them two subsystems are singled out – mainly formalized and mainly nonformalized. The latter sets external parameters for the former one as well as appropriateness of its individual procedures.

Efficient formalization of production systems provides for their minimal complement by external information. The complement is conditioned by the achieved level of study and interaction with the environment. Formalization of the kind enables implementation of the system approach to description of objects when formalization is a system of models interconnected by direct and reverse connections [9, 10]. To model production systems, it is expedient to apply a sufficient set of indicators grouped into a corresponding system with grounded limitations that, in their turn, consider possible development of these systems.

As a rule, the level of regional development is assessed with different indicators that can be divided into environmental, economic, social and political ones. On the basis of the study conducted by the authors, the following indicators are considered as the most significant ones:

- economic: the gross regional product (GRP); the gross added value in base prices; output in base prices;
- social: property incomes (earned).

Ukraine shows little practice of using political indicators and they are not practically applied to determining the regional development level.

At present, systems of economic and mathematical models are widely used in research; however, they are in isolation of each other. As a rule, they do not have a common goal, indicators or available resources. This enhances efficiency of research studies in comparison with the non-system approach but does not conform to the modern level of scientific achievements or their implementation in economic activities.

Advanced countries' practice shows that solution of complicated economic tasks requires not stereotyped models and methods but an interrelated complex of complementing systems of goals, limitations, priorities, generalizing indicators, action plans, implementation steps, and so on.

Transformation processes in Ukraine's economy impact greatly the living of all the regions, economic entities and production systems in particular. The instable external environment and low adaptivity of enterprises to any market transformations create unsafe conditions for their activities.

Theory and methods of forming productive systems' competitive potential, its structure, use, development of diagnostics, choosing potential development trends still remain unsolved and this is considered to be a topical problem nowadays.

Substantiation of harmonization of productive systems' methods and models requires commensuration of indicators that cannot be compared directly: volumes of production output, prices of various kinds of products, and others. Application of statistical index methods enables solution of such problems. Indices help reduce quantitatively non-comparable values to a certain general unity that enables their comparison.

The indices are widely used in all spheres of countries' and their regions' life, in enterprises' and organizations' activities. In particular, the index method of the factor analysis of indicators enables measuring impacts of multiple interconnected factors in the form of the product or the sum of products [11].

A special part is played by the index method of analysis in the process of measuring effectiveness of the socio-economic structural policy. Development of economy is increasingly connected with structural transformation. This is seen at all levels of management – from international and national ones to those of individual enterprises. At each level structural transformation is performed according to certain criteria.

Thus, the criterion of the structural policy efficiency at the government level is securing national interests that are determined by the scope of an individual's, society's and country's basic interests in the economic, international and national, social and informational spheres, people's cultural and spiritual life on the basis of the national security concept.

At the production systems level, the purpose of structural transformation is to increase efficiency of recourse concentration in the subdivisions with the highest ability to sell new products and technologies, patents and inventions per unit of costs, accelerate spent money turnover and, on the whole, enhance performance, provide financial stability considering market requirements. To meet the conditions, an enterprise should understand the specificity of management under competition, consider success and risk factors. In such conditions, preference is given to enhancement of management on the basis of knowledge management.

Though the theory of the management toolkit for analyzing efficiency of business is well known, in practice application of relevant knowledge is imperfect, particularly due to absence of adequate methods for assessing indicators that characterize the actual financial and economic state of an enterprise.

Thus, the efficiency level is represented by not individual but average values. That is why, when analyzing the medium level dynamics, a task arises to determine alterations of the medium level caused by each of the mentioned factors. This can be solved by applying the following system of interconnected indices.

General average efficiency depends, on the one hand, on the efficiency level in individual regions and industries (E_i), on the other hand, – on a part of each economic subdivision in total costs d_i. Impacts of each of these factors are calculated through the system of indices of changed and fixed weights as well as structural shifts.

The index of changed weight efficiency is used in the combined distribution by regions and industries and calculated by formula

$$I^{c.w.} = \frac{\sum\left(\sum E_1^i d_1^i\right) d_1^r}{\sum\left(\sum E_0^i d_0^i\right) d_0^r},$$

where E_i is the efficiency level in individual industries; d_1^r is the part of individual regions' resources; d_1^i is the part of resources of individual industries within the regions.

The index of fixed weights describes influence on dynamics of the medium efficiency change level in individual industries within the regions and is calculated by formula

$$I^{f.w.} = \frac{\sum\left(\sum E_1^i d_1^i\right) d_1^r}{\sum\left(\sum E_0^i d_1^i\right) d_1^r}.$$

The first order index of structural shifts describes influence of structural shifts in distribution of resources among industries within the regions and is calculated by formula

$$I^{s.s.(1)} = \frac{\sum\left(\sum E_1^i d_1^i\right) d_1^r}{\sum\left(\sum E_0^i d_0^i\right) d_1^r}.$$

The second order index of structural shifts determines influence of structural shifts in distribution of resources by among the regions and is calculated by formula

$$I^{s.s.(2)} = \frac{\sum\left(\sum E_0^i d_0^i\right) d_1^r}{\sum\left(\sum E_0^i d_0^i\right) d_0^r}.$$

Influence of individual factors on effect dynamics is calculated on the basis of the chain substitution method.

So, influence of the intensive factor, i.e. the efficiency level, is calculated by formula

$$\Delta PRP_E = (E_1 - E_0)R_1,$$

where PRP is production resources of the period; E_1, E_0 are efficiency of the production system in the current and base periods, respectively; R_1 is resources in the current period.

Also, it is possible to determine influence of the extensive factor, i.e. changes in the volume of resources, by formula

$$\Delta PRP_p = (R_1 - R_0)E_0,$$

where R_0 is resources of the production system of the base period.

Thus, application of the index approach to studying regularities of impacts of individual intensive and extensive factors of production is the basis for developing measures for enhancing performance of national enterprises and regions.

Dmyterko K. notes that nowadays, especially under globalization, traditional division of economy into sectors or industries is losing its applicability. Clusters as systems of interconnections between economic entities are stepping forward. The cluster takes maximal account of the market mechanism and is only efficient in conditions when it is initiated by enterprises. Efficiency of such clusters functioning results from market conditions. At present, in Ukraine's leading industries there have appeared so called "spontaneous" clusters. However, these structures are just developing and, under favorable market conditions and in the course of time, they may become clusters with the established system of interconnections [12].

In developed countries, the cluster approach to management has a considerable history. Thus, industries of Finland and Scandinavia are fully clustered. In the USA, over half of enterprises apply this model: enterprises-clusters are located in one region and use its natural, personnel and integrating potential to the fullest extent. The EU countries have adopted the Scottish model with a large enterprise as a core around which small firms are concentrated. More flexible cooperation of small, medium and big businesses is represented in the Italian model.

These countries' practice demonstrates that the cluster approach is the basis for a constructive dialogue between representatives of the business sector and the state. It enables more efficient cooperation of the private sector, the government, trade associations, research and educational institutions in the innovative process.

An important feature of a cluster is its innovative orientation. The most successful clusters are formed in the sphere where a tremendous technological development of production with further rise to a new level of functioning is possible. That is why many countries – both economically developed and developing – are actively using the cluster approach to designing their own innovative strategies of development.

Diversity and individuality of clusters complicate their typification. There exist various definitions of this form of relations between different business entities. A cluster as a sustainable partnership of interdependent enterprises, organizations, individuals can have a potential that exceeds a prime sum of separate components' potentials. This augmentation results from long-term cooperation and efficient use of partners' potentials, the unity of cooperation and competition.

At present, Ukraine's economic situation is aggravated. The country's goal is to not only increase the economic development level but also take the rightful place in the global community. Development of the new economy, enhancement of efficiency and competitiveness of Ukrainian enterprises are prerequisites for this and can be achieved, in particular, through application of the cluster approach to management of its economy.

The purpose of clusterization as an economic and mathematical modeling method is determining local "concentration" of the country's regions on the basis of calculating a similarity matrix for selected indicators. The matrix contains distance criteria, i.e. numerical characteristics describing strength of relations between every two objects. At present, there exist a number of methods of cluster grouping and their modifications. In general, the algorithm of clusterization consists in a certain enumeration of a number of clusters and determination of its optimal meaning.

To study interconnections of Ukraine's regions on the basis of analysis of the most important economic and social indicators of their functioning, the Euclid distance criterion of the matrix of their cross-correlations is chosen as they are statistically substantiated and reliable characteristics of measuring strength of relations between objects. The minimal spanning tree (MST) and a hierarchical tree show existence of clusters based on the chosen indicators.

Modeling is performed in Matlab. The algorithm of cluster formation is practically tested during previous investigations

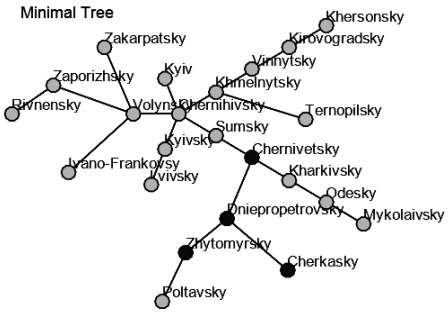

Fig. 1. The spanning tree for the regions of Ukraine based on the indicator of the gross regional product for the period of 2003–2017

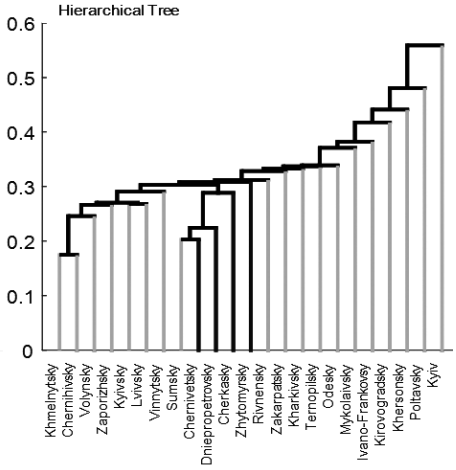

Fig. 2. The hierarchical tree for the regions of Ukraine based on the indicator of the gross regional product for the period of 2003–2017

and in works of other authors, in particular in [13]. To build the minimal spanning tree the following steps are undertaken:

1) all the Euclid distance matrix elements are placed in the ascending order (each successive element is bigger than or equal to the previous one);

2) a pair of elements with the shortest distance is chosen and it is the starting point of building MST;

3) successive elements with the shortest distance are chosen and added.

The procedure is fulfilled till all the elements are included in the tree. If a pair of elements is already included into MST, connection between them is not reflected. The structure of the hierarchal tree results from the ultrametric distance matrix and MST related to it [13].

So, on the basis of the above algorithm and using corresponding information [14, 15], there are built spanning and

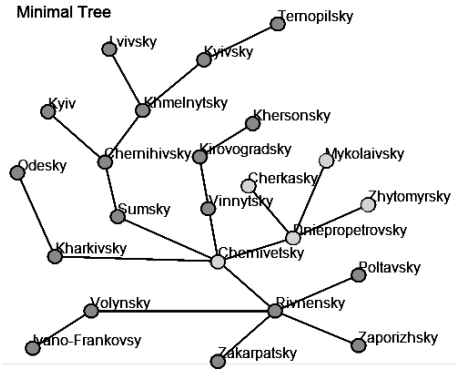

Fig. 3. The spanning tree for the regions of Ukraine based on the indicator of the gross added value in base prices for the period of 2003–2017

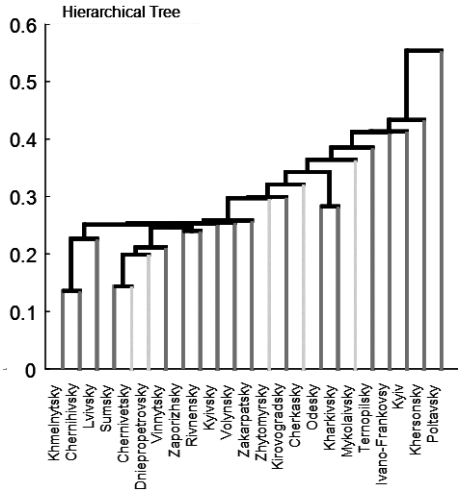

Fig. 4. The hierarchical tree for the regions of Ukraine based on the indicator of the gross added value in base prices for the period of 2003–2017

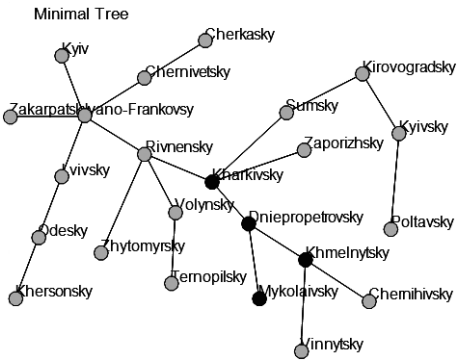

Fig. 5. The spanning tree for the regions of Ukraine based on the indicator of the property incomes (earned) for the period of 2003–2017

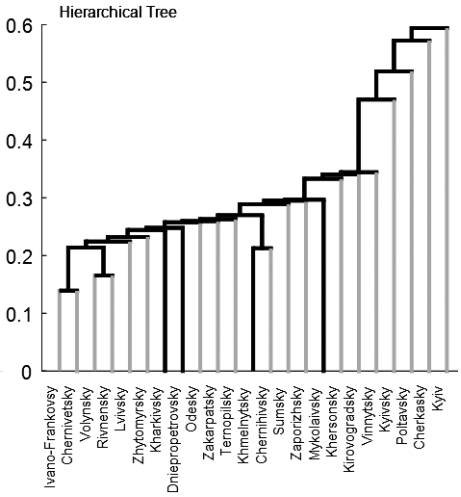

Fig. 6. The hierarchical tree for the regions of Ukraine based on the indicator of the property incomes (earned) for the period of 2003–2017

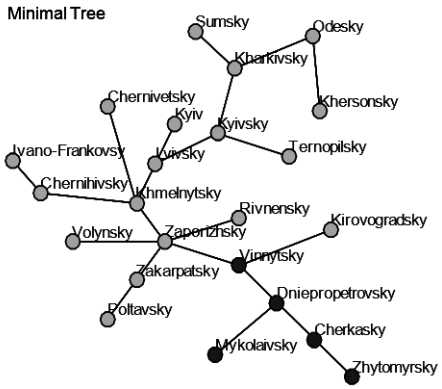

Fig. 7. The spanning tree for the regions of Ukraine based on the indicator of output in base prices for the period of 2003–2017

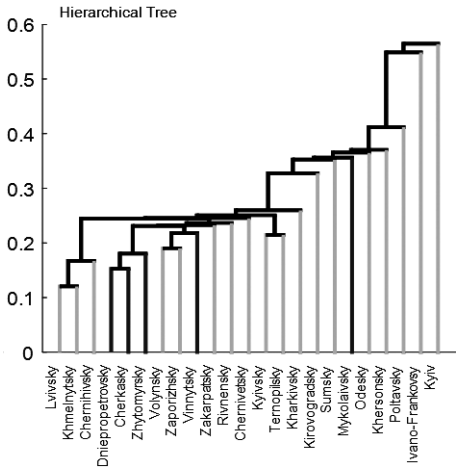

Fig. 8. The hierarchical tree for the regions of Ukraine based on the indicator of output in base prices for the period of 2003–2017

Table

Grouping of regions of Ukraine according to main indicators of their economic development level (developed by the author on the basis of [13–15])

Factors	Gross regional product	Gross added value in baseprices	Property incomes (earned)	Output in base prices
Regions forming a cluster with Dniepropetrovsky region	Chernivetsky	Chernivetsky		
	Zhytomyrsky	Zhytomyrsky		Zhytomyrsky
	Cherkasky	Cherkasky		Cherkasky
		Mykolaivsky	Mykolaivsky	Mykolaivsky
			Kharkivsky	
			Khmelnytsky	
				Vinnytsky

hierarchal trees for the regions of Ukraine for the period of 2003–2017 (Figs. 1–8).

As is seen in Fig. 1, according to the gross regional product indicator, Dniepropetrovsky region is part of the cluster with Cherkasky, Zhytomyrsky and Chernivetsky regions. This indicator describes the level of economic development and results of economic activities of all economic entities of the region. That is, dynamics of these regions' economic development level is almost the same.

The similar picture is reflected in Fig. 2 that presents the hierarchical tree of Euclid distances for the gross regional product indicator.

The results of the study of Ukraine's regions grouping according to the gross added value indicator and possibility of clusterization of the region according to this indicator are given in Figs. 3, 4.

As is known, the gross added value indicator describes results of production economic activities. The gross added value created by regional economy consists of labor costs, fixed capital consumption and net profit. That is, according to dynamics of regional production efficiency, the applied methods of analysis enable singling out the cluster formed by Dniepropetrovsky region along with Cherkasky, Mykolaivsky, Zhytomyrsky and Chernivetsky regions.

The other indicator chosen for the analysis of the taxonomic grouping of regions is property incomes (earned) that reflects the level of business development of regions and characterizes additional incomes of producers.

Fig. 5 presents the spanning tree of clusterization of Ukraine's regions according to the chosen indicator. Here, Dniepropetrovsky region forms a cluster with Mykolaivsky, Khmelnytsky and Kharkivsky regions. This testifies to the interdependence of the property incomes (earned) indicators for these regions.

Fig. 6 shows that in terms of the property incomes (earned) indicator Dniepropetrovsky region has the strongest connections with Kharkivsky region.

The results of modeling interconnections between Ukraine's regions based on the indicator of output in base prices that characterizes total production volumes of the regions are presented in Figs. 7, 8.

As is seen from Fig. 7, in terms of dynamics of base products Dniepropetrovsky region forms a cluster with Mykolaivsky, Cherkasky, Vinnytsky and Zhytomyrsky regions.

The similar picture results from the analysis of the hierarchal tree based on the corresponding indicator for the regions of Ukraine (Fig. 8).

Fig. 8 shows that in terms of the indicator of output in base prices Dniepropetrovsky region has the strongest connections with Zhytomyrsky and Cherkasky regions.

Thus, according to the formed clusters, there can be singled out regions with the strongest connections in terms of the indicators under study (Table).

Thus, for most of the indicators under study stable connections exist between Dniepropetrovsky, Cherkasky, Zhytomyrsky and Mykolaivsky regions. Determination of such connections is an important basis for making rational managerial decisions in order to enhance competitiveness and economic growth of regions and, consequently, an essential condition of enhancing people's living standards.

Conclusions. Thus, at the contemporary stage of development of the applied economic and mathematical toolkit there exist a great number of models of studying economic processes that differ in both quantity and relations of indicators. In particular, models of production systems are characterized by such features as specific forms of implementation of principles of market self-regulation; conditions and forms of establishing and developing production systems specific for each region; stages of establishing the economic system on the way to the developed market economy.

The studies conducted enable, on the basis of harmonization of cluster and index modeling, determining clusters according to their most significant economic indicators. Enterprises of Dnieproperovsky region are a driving force of Ukraine's heavy industry and economy as a whole.

Creation of cluster and index models makes a basis for further research when building multifactor regression and forecasting models. Building of such models enables determining the most promising trends of development of regional productive systems and ensuring rational management of socio-economic processes.

References.

1. Dzenis, V., & Dzenis, O. (2018). Areas of adaptation of enterprises to the conditions of a competitive environment. In *Economic development and heritage of Semen Kuznets*. International research and practice conference, (pp. 53-54). Retrieved from http://www.skced.hneu.edu.ua/files/tez_konferencii_simon_kuznets_14_05_18.pdf#page=53.

2. Vasyltsiv, T. H. (2015). Formation of the environment of economic security of entrepreneurship in Ukraine *Ekonomichnyi chasopys-KhKhI*, *3-4*(1), 24-27.

3. Tkachenko, A. M., & Marchenko, K. A. (2014). Modern approaches to managing the development of the enterprise. *Ekonomika i rehion*, *1*, 85-90.

4. Moiseienko, I. P., Revak, I. O., & Demchyshyn, M. Ya. (2013). Modeling of economic security of the state by parameters of intellectual potential. *Aktualni problemy ekonomiky, 12*, 278-285.

5. Dmytryshyn, B. V., & Hamalii, V. F. (2013). Conceptual approach to modeling the productivity of economic systems based on inter-industry balance. *Naukovi pratsi Kirovohradskoho Natsionalnoho Tekhnichnoho Universytetu. Ekonomichni nauky*, *24*, 8-15.

6. Cherevko, O. V. (2014). Strategy of social and economic development of regions of Ukraine. *Efektyvna ekonomika, 2*, 1-4.

7. Yelisieieva, O. K., & Kutova, N. G. (2017). Assessment of the mechanism of stimulation of enterprises. *Biznes Inform*, (5), 76-81.
8. Burkova, L. A. (2014). Theoretical bases for assessing the efficiency of enterprises and ways of its improvement. *Innovaciina ekonomika,* (4), 145-153.
9. Sukhorukov, A. I., & Kharazishvili, Yu. M. (2012). *Modeling and forecasting of socio-economic development of regions of Ukraine*. Kyiv: NISD.
10. Stetsenko, I. V., & Litvinov, V. V. (2012). Management of distributed grid system resources. *Matematychni mashyny i systemy, 2*, 3-12.
11. Beridze, T. M. (2016). *Statistical monitoring in the enterprise strategic management system: monograph*. Kremenchuk: PP Scherbatykh O. V.
12. Dmyterko, M. O. (2015). Methodical bases of estimation of efficiency of clusters in economy. *Problemy i perspektyvy rozvytku pidpryiemnytstva, 4*, 92-98.
13. Tkachuk, I., & Kropelnytska, S. (2014). *Strategic priorities of socio-economic development of the region: monograph*. Ivano-Frankivsk: Vydavets Viktor Diakiv.
14. State Statistics Service of Ukraine (n.d.). Retrieved from http://www.ukrstat.gov.ua/.
15. SMIDA (n.d.). *Account of information services. Reports of enterprises*. Retrieved from http://smida.gov.ua/.

Гармонізація результатів моделювання виробничих систем регіонів України

Т. М. Берідзе[1], *Н. В. Лохман*[2], *О. О. Бондаренко*[3], *А. В. Бугра*[4]

1 – Криворізький факультет Запорізького національного університету, м. Кривий Ріг, Україна, email: beridzet2016@gmail.com
2 – Донецький національний університет економіки і торгівлі імені Михайла Туган-Барановського, м. Кривий Ріг, Україна, email: aleks.lokhman@gmail.com
3 – Криворізький економічний інститут Київського національного економічного університету імені Вадима Гетьмана, м. Кривий Ріг, Україна, email: bondarenko0708@gmail.com
4 – Криворізький національний університет, м. Кривий Ріг, Україна, email: alina.bugra@gmail.com

Мета. Встановлення системних міжрегіональних виробничих зв'язків, аналіз корпоративних характеристик виробничих систем, формування прикладного науково-методичного забезпечення.

Методика. Сформовано інструментарій економіко-математичного моделювання з метою аналізу та оцінювання характеристик основних регіональних показників. Проаналізовані економічні й соціальні показники, які є суттєвими при регіональному розподілі ресурсів. На рівні окремих виробничих систем структурна трансформація має за мету підвищення ефективності концентрації ресурсів у підрозділах з вищою віддачею. Передумовою формування раціональних управлінських рішень є ретельний, якісний аналіз складних виробничих систем, наявність ресурсів і їх розподіл.

Результати. Визначені системні міжрегіональні зв'язки, корпоративні характеристики виробничих систем, що дозволило означити кластери за визначеними показниками й довести раціональність застосування відповідних моделей, визначити ефективність регіонального розподілу ресурсів.

Наукова новизна. Інноваційний підхід щодо формування методики гармонізації кластерного та індексного моделювання дозволив провести відповідний аналіз задля ефективних управлінських рекомендацій.

Практична значимість. Практичний досвід застосування запропонованої методики довів її дієвість щодо прийняття раціональних управлінських рішень з метою забезпечення економічного зростання регіонів. Сформовані кластери й побудовані індексні моделі, що є основою для подальших досліджень із побудови багатофакторних регресійних моделей і моделей прогнозування.

Ключові слова: *моделювання, регіон, виробнича система, індекси, ресурси, кластер*

Гармонизация результатов моделирования производственных систем регионов Украины

Т. М. Беридзе[1], *Н. В. Лохман*[2], *Е. А. Бондаренко*[3], *А. В. Бугра*[4]

1 – Криворожский факультет Запорожского национального университета, г. Кривой Рог, Украина, email: beridzet2016@gmail.com
2 – Донецкий национальный университет экономики и торговли имени Михаила Туган-Барановского, г. Кривой Рог, Украина, email: aleks.lokhman@gmail.com
3 – Криворожский экономический институт Киевского национального экономического университета имени Вадима Гетьмана, г. Кривой Рог, Украина, email: bondarenko0708@gmail.com
4 – Криворожский национальный университет, г. Кривой Рог, Украина, email: alina.bugra@gmail.com

Цель. Установление системных межрегиональных производственных связей, анализ корпоративных характеристик производственных систем, формирование прикладного научно-методического обеспечения.

Методика. Сформирован инструментарий экономико-математического моделирования с целью анализа и оценки характеристик основных региональных показателей. Проанализированы экономические и социальные показатели, которые являются существенными при региональном распределения ресурсов. На уровне отдельных производственных систем структурная трансформация имеет целью повышение эффективности концентрации ресурсов в подразделениях с высокой отдачей. Предпосылкой формирования рациональных управленческих решений является тщательный качественный анализ сложных производственных систем, наличие ресурсов и их распределение.

Результаты. Определены системные межрегиональные связи, корпоративные характеристики производственных систем, что позволило обозначить кластеры по определенным показателям и доказать рациональность применения соответствующих моделей, определить эффективность регионального распределения ресурсов.

Научная новизна. Инновационный подход к формированию методики гармонизации кластерного и индексного моделирования позволил провести соответствующий анализ для эффективных управленческих рекомендаций.

Практическая значимость. Практический опыт применения предложенной методики доказал ее действенность по принятию рациональных управленческих решений с целью обеспечения экономического роста регионов. Сформированы кластеры и построены индексные модели, которые являются основой для дальнейших исследований по построению многофакторных регрессионных моделей и моделей прогнозирования.

Ключевые слова: *моделирование, регион, производственная система, индексы, ресурсы, кластер*

Recommended for publication by Ye. V. Afanasiev, Doctor of Economic Sciences. The manuscript was submitted 17.03.19.