PRINCIPLES AND MECHANISMS OF REGIONAL ECONOMIC SYSTEMS RECOVERY AND DEVELOPMENT

ПРИНЦИПИ І МЕХАНІЗМИ ВІДНОВЛЕННЯ ТА РОЗВИТКУ РЕГІОНАЛЬНИХ ЕКОНОМІЧНИХ СИСТЕМ

Oleksandr I. Laiko, DEcon, Professor
*SO "Institute of market and economic-ecological research of the NAS of Ukraine",
Odesa, Ukraine*
ORCID: 0000-0001-7082-0862
Email: alexlayko@gmail.com

Mykhailo B. Yezhov, PhD in physics and mathematics
*SO "Institute of market and economic-ecological research of the NAS of Ukraine",
Odesa, Ukraine*
ORCID: 0000-0001-5003-7774
Email: isanybodyhome63@gmail.com

Лайко О.І., Єжов М.Б. Принципи і механізми відновлення та розвитку регіональних економічних систем. Науково-методична стаття.

Задачі підвищення ступеню згуртованості та конвергентності є одними з ключових для повоєнного відновлення та розвитку регіональних економічних систем, визнані ключовими в Державній стратегії регіонального розвитку України, Плані повоєнного відновлення, що наближує національні цілі регіонального розвитку до Європейських. Для реалізації задач повоєнного відновлення та подальшого розвитку регіональних економічних систем (РЕС) на засадах ефективного використання наявних ресурсів необхідно розробити методичний інструментарій, визначити стратегічні принципи побудови та розвитку РЕС. Зазначено особливості функціонування РЕС в період післявоєнного відновлення. Введено поняття «згуртованісті знизу» та «згуртованісті зверху». Проведено аналогію між управлінням РЕС та координацією діяльності підприємств у рамках стратегії CPFR. Розглянуто засоби стимулювання кооперації в РЕС, зокрема інституційні механізми та інформаційні технології. Побудовано імітаційні моделі господарських кооперативних підсистем за допомогою програми iThink.

Ключові слова: економічна система, згуртованність децентралізація, регіоналізація, глобалізація, глокалізація, фрактальність, мережі, граф, самовідтворення, солідарність, солідаризм, структурність, кооперація, консенсус

Laiko O.I., Yezhov M.B. Principles and Mechanisms of Regional Economic Systems Recovery and Development. Scientific and methodical article.

The tasks of increasing the degree of cohesion and convergence are among the key ones for the post-war recovery and development of regional economic systems. They aim of socio-economic cohesion increase is mentioned as the main in the State Strategy for Regional Development of Ukraine, in the Post-War Recovery Plan, at it brings national regional development goals closer to European ones. In order to implement the tasks of post-war recovery and further development of regional economic systems (RES) based on the effective use of available resources, it is necessary to develop a methodological toolkit, to define strategic principles for the construction and development of RES. The peculiarities of the operation of RES in the period of post-war recovery are indicated. The concepts of "solidarity from below" and "solidarity from above" are introduced. An analogy is drawn between the management of the RES and the coordination of the activities of enterprises within the framework of the CPFR strategy. The means of stimulating cooperation in the RES, in particular institutional mechanisms and information technologies, are considered. Simulation models of economic cooperative subsystems were built using the iThink program.

Keywords: economic system, cohesion, decentralization, regionalization, globalization, glocalization, fractality, networks, graph, self-reproduction, solidarity, solidarism, structurality, cooperation, consensus

The management of decentralized economic systems has fundamental differences from the management of centralized hierarchical systems. The authors were faced with the task of researching the principles and mechanisms of such management, showing the role of cohesion and solidarity of the participants in the system. Despite numerous studies by domestic and foreign authors, the basic principles and mechanisms for the construction and development of regional economic systems have not been clearly formulated.

Analysis of recent research and publications

The issues of development of regional economic systems have been studied by many domestic and foreign experts. R.J. Barro and J. Sala&Martin have explored the convergence of regions. W.R. Barnes and L.C. Ledebur considered economic regions as structural units of the national economy, studied the interaction of the regional and global economies. M. Castells considered the network structure of the modern economy. Ukrainian economists O. Tkachuk, E. Lapin, M. Datsyshyn considered the concept of cohesion in social and economic aspects, but did not emphasize the economic component.

The aim of the article is to determine the methodological principles of regional economic systems (RES) building and developing, to propose the measures on stimulation of cooperation between RES enterprises and methods of modeling RES for the purpose of planning and managing them.

The main part

An outline of the main results and their justification. We identify three main strategic

principles for the design and development of regional economic systems (RES):

1. The principle of structure.
2. The principle of network control.
3. The principle of economic solidarity.

Let's consider each of these principles in detail.

1. The principle of structure.

The regional economic system must first of all have a certain structure. The structure of the RES is important for its survival. It is convenient to represent this structure as a network (in the mathematical sense), that is, as a directed connected graph [1]. Vertices (nodes) of the network correspond to enterprises, and arcs (oriented edges) are connections between enterprises, which are expressed in the movement of goods from one enterprise to another [2]. The flow along the arc corresponds to the price of the product. Commodity flows correspond to counter cash flows. Such a network must be branched and include closed paths (contours or oriented cycles). A similar structure of RES ensues the partial autonomy of the system and, consequently, it steadfastness before the external perturbation.

The elements of the regional economic system as a whole, together with connections, form a complex network of interconnected chains of added value creation and financial support for the reproduction of spent resources. Some aggregate of communities (district, part of district, or region) can be considered as a minimum RES. The minimum size of RES depends on the level of industrial development in the region. The world economic system can be seen as a hierarchy of networks, in which individual networks themselves are nodes from the point of view of a higher-level network. At each level, the network structure locally looks like this (Fig. 1).
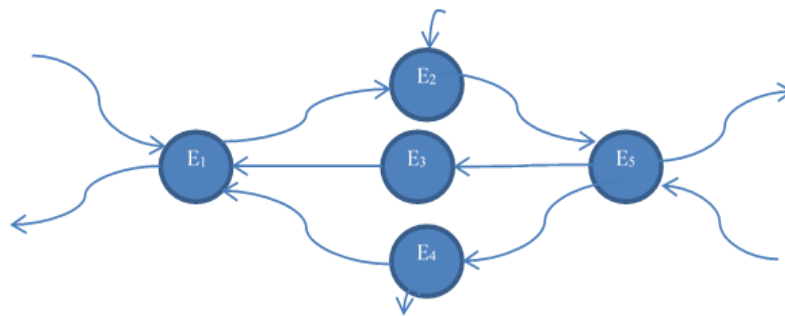

Figure 1. The network local structure at each level in the form of a directed connected graph
Source: authors' own elaboration

Here, the vertices (nodes) – E1, E2…En of the network correspond to enterprises or local economic systems, and the arcs (oriented edges) correspond to the connections between them.

Suppose the need of considering the task of economic system development at the district level. The same structure, taking into account the requirements for maintaining the stability of the system, should have economic ties at the next structural level of the economic network – for example, at the level of the region. Here, the nodes will be the RES of the previous level. That is, the circuit shown in Fig. 1 is scaled. Above the level of the region is the level of the national economy. Such an idealized economic system has the property of self-similarity in some non-strict sense, so its structure can be called quasi-fractal [3].

In accordance with this principle, production chains in the RES should be built. Note that the population plays an important role in the RES. If we include the population in the network together with enterprises as a separate node, we will see that it is a link in the system, that is, it ensures the connectivity of the corresponding network in the mathematical sense. In addition, the presence of the population in the network as a separate node (i.e., the population is considered as an independent subject of economic activity) increases the number of circuits in it. This means that the production of goods for the population improves the structural properties of RES. The RES scheme, in which the population is an element of the network, will be considered later in this article.

2. The principle of network control.

The management of RES should be considered in the context of the decentralization reform. The network structure, together with the lack of a single control center, leads to the consideration of the problem of managing the RES from the point of view of network control. From the point of view of control theory [4], RES control should be decentralized and partially distributed.

The first term means that each control center works autonomously and uses only local information about the system, and the second means that the control centers perform some functions jointly. For this, information is exchanged between them to coordinate control with the aim of achieving a common goal. Such type of control is also called cooperative control. The management of a flotilla of ships is one of examples of cooperative control when each ship has a certain degree of autonomy in performing its own share in a common task, and has its role in the overall process of coordination.

3. The principle of economic solidarity and their components.

Economic solidarity in our interpretation means mutual assistance, cooperation. Cooperation involves the coordination of the activities of economic entities. It means that the development of economic activities can be planned and managed. We will consider

planning and management based on the principle of network control, which we considered earlier. Planning and management are used to achieve the necessary parameters of the economic system and maintain a dynamic balance in it. The concept of solidarity is quite close to the concept of cohesion. Probably, one can say that solidarity is the path to cohesion. However, the concept of solidarity is more constructive.

Note that these three principles are interconnected and complement each other. Most of the other principles defined in modern documents in the field of ensuring the development of regional economic systems in Ukraine and the EU follow from them: decentralization, subsidiarity, participation, sustainability, etc.

Let's consider the principle of economic solidarity in more detail.

In the first period of post-war recovery, when working in the state of emergency, measures that are in the direction of the mobilization economy are justified.

This can be called "solidarity from above". It means that the main criterion is not the current profit of enterprises, but the provision of the economy with the most necessary products. The mobilization economy provides for a number of organizational measures:

— carrying out monitoring of the main industrial enterprises with the purpose of determining the possibility of the production of goods necessary for the population during the period of the post-war renewal;

— conducting monitoring of the transport industry and warehousing in order to determine the possibility of restoring the logistics system of Ukraine;

— using of reserves of the State Reserve to help strategic sectors of the economy;

— using of public procurement to stimulate strategic sectors of the economy;

— placement of state orders at enterprises for the production of necessary products, etc.

As the economy enters a peaceful course, a transition is gradually being made to more flexible and less prescriptive planning and management, namely, network control.

Management in a decentralized RES should be based on economic solidarity; its main strategic goal is the development of cooperation. Economic solidarity means mutual assistance, cooperation, orienting the economy to a long-term perspective and sustainable development, not to short-term gain and profit at any price. The result of management should be the predominance of cooperation over competition, the establishment of the maximum number of economic ties between the participants of the RES. This can be called "solidarity from below".

The management of RES on the basis of economic solidarity should contribute to the stability of its structure, in this case it plays a role of "glue" that helps to provide its integrity.

Let us note the connection between the principle of economic solidarity and the concept of sustainable development. For RESs operating on the basis of solidarity, sustainable development is a natural principle (participants of economic activity are interested in preserving the natural complex and social stability), while for a classic liberal economy, the concept of sustainable development is rather an additional obstacle to development. Therefore, most of the sustainable development goals (hunger and poverty elimination, agricultural development, decent work and economic growth, inequality reduction, etc.) are natural for solidary RES.

Some authors believe [5] that it is cooperative forms of organization that can ensure the competitiveness of small business entities by uniting them. In addition, cooperation contributes to the diversification of business and the saturation of regional markets with more diverse products. First of all, this concerns agricultural cooperatives, since large agricultural holdings in Ukraine specialize in products mainly of grain and oil groups. That is, agricultural cooperatives are a factor of survival and competitiveness of the agricultural sector in the conditions of globalization [6].

Another example of successful cooperation is citizen energy cooperatives (CECOs) in north western Germany [7]. These cooperatives are an example of the transformation of the energy system into a decentralized system with the participation of many citizens..

An analogy can be drawn between cooperation in the RES and the coordination of the activities of enterprises participating in the supply chain of goods or other material values. An example of this kind is the CPFR strategy (Collaborative planning, forecasting, and replenishment). This initiative was founded in 1995 by the board of Walmart, which was interested in reducing transportation and warehousing costs by working more closely with its partners throughout the logistics chain.

The CPFR strategy includes a 5-step workflow:

1) concluding a partnership agreement between supply chain participants – defining goals (reducing inventory levels, preventing sales losses or product spoilage), determining necessary resources for cooperation (technical equipment, software), choosing confidentiality tools;

2) joint business planning (formulation of a partnership strategy, development of a joint register of events in the form of planning and criteria for disagreement between partners);

3) making demand forecasts (taking into account simple forecasting methods with expert adjustments);

4) mutual exchange of forecasts (exchange of demand forecasts of the supplier and the buyer, in case of disagreement, the procedure for developing a mutual consensus forecast begins);

5) stock replenishment (the forecast actually becomes an order, on the basis of which the stock replenishment procedure is launched (production/purchase).

During the implementation of this process, it is necessary to solve the following problems:

1. mutual mistrust between the process participants;

2. conflict of goals;

3. each of the participants tries to use operational data to gain an advantage in negotiations or in determining the market strategy;

4. issues related to commercial secrets.

An example of a strategy similar to CFPR could be the harmonization of prices and volumes of agricultural products supplies between producers of raw materials and a processing enterprise. Different mathematical models and programs can be used for planning: Leontief model, system dynamics models, etc. Examples of such models will be given below.

We think it appropriate to consider institutional mechanisms and information technologies as means of stimulating cooperation in the RES.

In order to facilitate the accelerated recovery of the economy and the creation of sustainable and capable RES, institutional support is needed, which can be implemented in terms of the following main components:

1. Maximization of the common good, which is created and reproduced in RES.

2. Support for localization and mutual assistance of participants, that is, preferences for regional producers.

Formal institutional arrangements may include:

1) Regional tax policy, which provides for tax benefits when buying or selling within the region. It is also proposed to introduce a grace period procedure for paying land tax before the start of operation of the enterprise or until the end of the payback period (a specific mechanism for the introduction of benefits is proposed to be worked out by local authorities in consultation with communities);

In addition to regional tax policy, local measures at the level of national tax policy can be effective in order to stimulate industrialization in the regions. An example can be Laws No. 5688 and 5689 dated 06/22/2021, which provide tax and customs benefits for industrial parks.

The first law provides for exemption from value-added tax when importing into Ukraine new equipment by participants of industrial parks. The benefit is valid in case of personal use of this equipment by the participants on the territory of the industrial park for target activities. The second law exempts from payment of import duties new equipment imported in the same situation.

2) Regional credit policy providing for preferential loans for RES enterprises.

Regional credit policy should be carried out by specialized organizations, for example, regional credit unions or mutual aid societies;

3) System of regional bill settlements.

4) Establishment of a regional land bank to implement the mortgage lending mechanism.

5) Mechanisms of horizontal equalization of the financial and budgetary capacity of territorial communities [8].

6) Mechanisms of civil society to harmonize common interests.

7) Preemptive right of communities to the property of enterprises located on their territory, in their sale, privatization or restructuring.

8) Establishment of the institution of solidary (common) community ownership for collective lands (pastures, ponds for fish farming, etc.) and enterprises with a large number of shares;

This topic is developed in the well-known work by Elinor Ostrom [9]. There are also works in which Ostrom's approach is applied to specific cases, for example [10].

Another formal institutional mechanism is social partnership (Labor Code of Ukraine [11]). This mechanism serves to harmonize the interests of workers and employers. It can also be implemented in RES through advisory bodies, joint commissions, etc. It should be noted that this mechanism, like any other mechanisms in the field of economic solidarity, is based on the ideology of solidarism.

Informal institutional mechanisms are primarily related to the use of social capital. The presence of stable social ties, including informal ones, trust between the participants of the RES – all this contributes to cooperation, solving reputational problems and reducing transaction costs. In addition, if the economic system is solidary and based on cooperation, then transactions in it take on a different, less conflictual character, and the emphasis in this case should be placed not on transaction costs, but on transaction value. The fact is that not only "friction", but also a new total cost arises when transactions are carried out [12], and in our opinion, this is especially relevant for transactions in a solidary economic system.

In such a system, enterprise transactions are aimed not only at minimizing costs and increasing its value, but also at increasing the value of the entire system. Therefore, it is necessary to take into account the mutual dependence of the enterprises participating in the transaction. Moreover, the pursuit of greater shared value often requires the use of a governance structure that is less efficient in terms of transaction costs [12]. However, the mutual benefits outweigh the arguments related to the minimization of transaction costs. Such a situation is typical if we consider the interaction of two or more firms from the point of view of their cooperation.

Transaction costs can be seen as one type of total cost that must be weighed against total benefit. The key points here are the need to take into account the interests of the partner in the agreement, the intention to find common interests, the intention for long-term cooperation.

Trust within the communities creates the preconditions for the participation of the communities' population in the management of the regional economy. Thus, economic governance becomes inclusive. Inclusive economic institutions are potentially a feature of solidary RESs. Such institutions make it possible to take into account the interests and opinions of the general population.

Information technologies can be considered as another tool for managing the regional economic system. Decentralized RES have a network structure. Therefore, for their planning and management, it is effective to use appropriate network information technologies, which involve the automation of management processes. Management is carried out through the organization of cooperation between the participants of this network.

One of the most demonstrative examples of such technology is multilateral platforms (eBay,Google Shopping, Uber, all.biz, prom.ua etc.). The specificity of these platforms is that they create competition – competitive cooperation [13].

The use of a multilateral platform provides the following advantages: access to significant information resources, network scalability and network effects (the value of the network increases with its growth). Cooperation at multilateral platform is built in two directions: in the direction of creating a production chain and in the direction of creating supplementary goods (supplementary services). It should be noted that for the effective organization of cooperation, multilateral platforms must have functionality that allows the creation of regional corporate communities. This supports the development of cooperation based on the territorial principle.

The use of information technology, in addition, can reduce transaction costs by automating and optimizing processes associated with business organizing, concluding transactions, and monitoring their implementation. It can be the following technologies: CRM and ERP systems, sites and applications for e-commerce, project management systems, logistics management systems, GPS monitoring systems. An important role in making management decisions in a decentralized control system should be played by automated consensus algorithms (e.g., Welphi https://www.welphi.com).

Information technologies make it possible to more effectively implement the methods of mathematical modeling, in particular simulation modeling. An example is the use of the iThink program for simulation modeling of the economic subsystem of the Podilskyi district of the Odesa region. At the same time, the Leontief model of the input-output balance of the same subsystem will be constructed. The articles [14, 15] substantiates the advisability of creating a flour mill in Podilsk on the basis of statistical data. Such a plant generates a local economic system, which is a subsystem of the regional economic system of the Podilsk region. Schematically, this can be represented as follows.

The functioning of this economic system can be modeled using the Leontief balance model. The model uses data obtained through a survey. These data are conditional, because the flour mill does not actually exist. The simulation results in value terms (million UAH) are shown in Table 1.

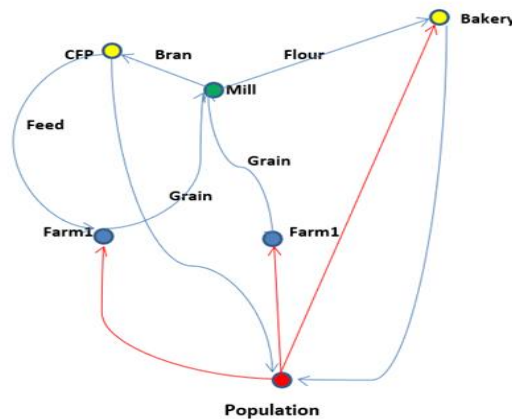The following notations are used in Table 1 and Fig. 2.

Figure 2. Subsystem for grain processing in the regional economic system,
on the basis of the Podilskyi district of the Odesa region
Source: authors' own elaboration

Table 1. The Leontief balance model for the regional economic system
of the Podilskyi district of the Odesa region

		Demand					Store	Total output
		Farm	Mill	KKZ	Bakery	Population	C	X
Activities	Farm	0.00	190.00	12.37	0.00	0.00	170.00	372.37
	Mill	0.00	0.00	82.44	70.01	25.56	50.00	228.00
	KKZ	93.09	0.00	0.00	0.00	25.56	5.00	123.65
	Bakery	0.00	0.00	0.00	0.00	51.12	50.00	101.12
	Population	111.71	57.00	20.61	15.17	51.12	0.00	255.61
		204.80	247.00	115.41	85.18	153.37	275.00	1080.76

Source: authors' own elaboration

Table 2. Notations list used for modeling

Notation	Explanation
Farm	agricultural enterprise
Mill	flour mill
CFP	compound feed plant
Bakery	bakery
Population	labour resources
Grain	grain produced by farms
Feed	feed produced by a compound feed plant

Source: authors' own elaboration

The total output for each enterprise is calculated according to its stock amount.

Note that the population is an element of the economic system together with Farm, Mill, CFP and Bakery enterprises, that is, it is considered as an independent subject of economic activity. Its role in the system is that it supplies its labour to enterprises in the same way that enterprises supply their products to each other. Thanks to the Leontief model, we can calculate the amount of labour resources necessary for the functioning of the existing economic system. The next model of the economic system shown in the Table 1 is a simulation model built using the program iThink (https://www.iseesystems.com) (Fig. 3).
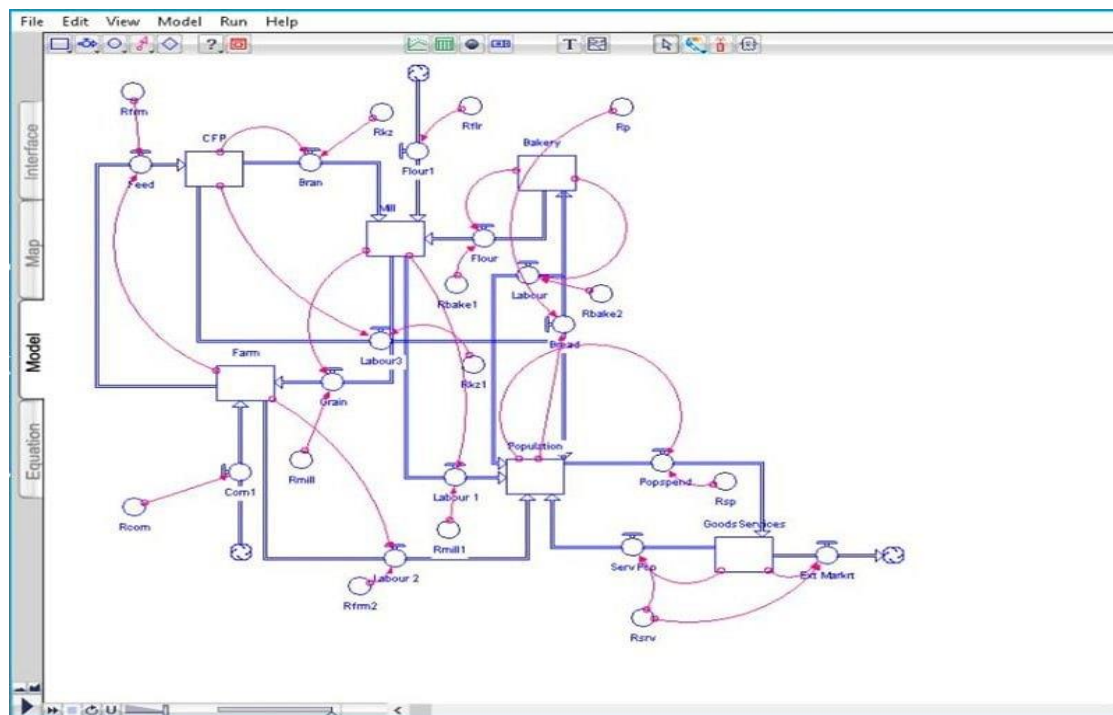

Figure 3. The schematic model of the subsystem for the industrial processing of grain products in the Podilskyi district, created using the iThink program
Source: authors' own elaboration

Such kind of model, created by means of the iThink program (Fig. 3), makes it possible to form a tool suitable for practical use, which is able to reflect the reaction of the industrial complex of the district to changes in business conditions, changes of supply prices and other production factors. It is possible to determine the scenarios for the development of the regional industrial complex, justification and calculation of management decisions. This model, in contrast to the Leontief model, makes it possible to monitor the dynamics of the system parameters. The arrows show the directions of money flows directed opposite to the corresponding commodity flows shown in Fig. 2. The model uses symbols from Table 1, additional symbols are given below.

Table 3. Notations list used for modeling

Notation	Explanation
Labour	labour used by the enterprise
Bran	bran produced by the bakery
Flour	flour produced by the bakery
Goods&Services	goods and services consumed by the population

Source: authors' own elaboration

The coefficients R with indices denote the shares of the corresponding expense items in the total income of the enterprise. The graph of the change in the model parameters is shown in Fig. 4.

The abscissa shows the time in months, the ordinate shows the net cash flow of the population and enterprises indicated in Table 2.
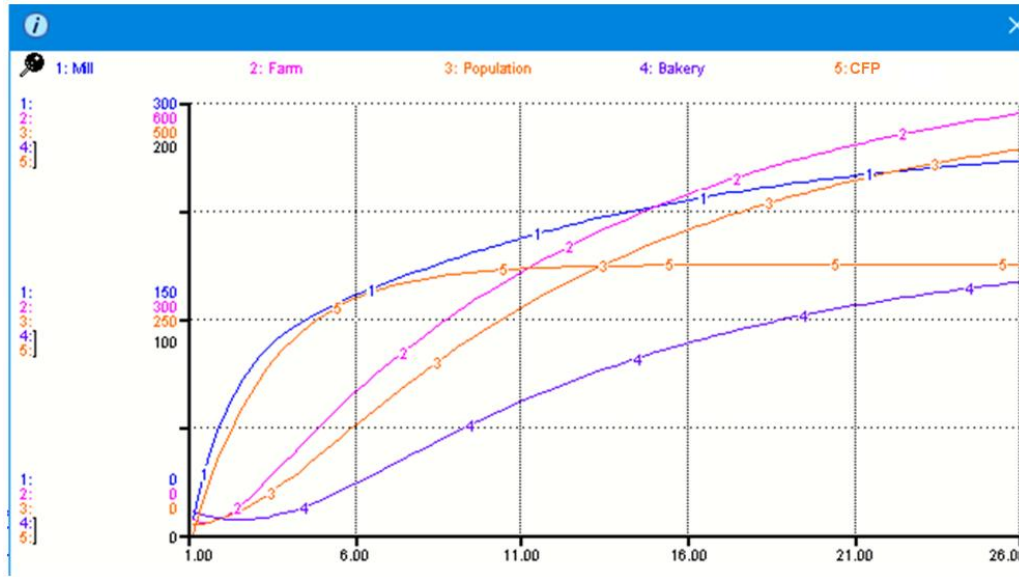

Figure 4. Graph of changes of net cash flows in the subsystem of industrial processing
of grain products in the Podylskyi district
Source: authors' own elaboration

It should be noted that the modeling of economic systems can become the basis for making decisions regarding the implementation of certain projects, planning optimal options for the organization and placement of enterprises in the territories, taking into account demand and the available resources. In addition, modeling can help coordinate the activities of enterprises in the process of their cooperation.

Information technologies can also be considered as a tool for the development of social capital. The first step to this can be the creation of groups in social networks (Facebook, Instagram) or messengers (Viber, WhatsApp, Telegram), which will include representatives of communities, administrations, economists and public organizations. These groups

can host anonymous online polls and votes as a consensus mechanism. In this case, information technologies work like social technologies: due to the growth of communications, they contribute to the development of social capital. This, in turn, contributes to the growth of community solidarity in the region. The next step may be to use more sophisticated technologies, such as Welphi.

Given the above, we see that the triad Information Technology - Social Capital - Transaction Costs forms a system, the interaction of elements of which is significant (see Fig. 5). The figure shows that the systemic effect is obtained primarily due to the influence of information technology.
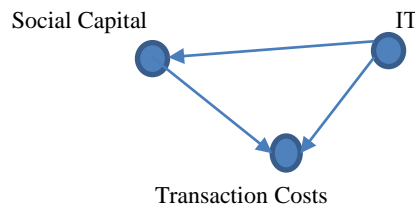

Figure 5 The triad interaction system of elements: Information Technology - Social Capital - Transaction Costs
Source: authors' own elaboration

At the end, let us consider the issues of interaction between RES and the global economy. In our opinion, RES built on the basis of solidarity are in dialectical unity with the global economy. On the one hand, RES entities are part of the world economy and can enter the world market, and on the other hand, the world economy should be based on regions that are

prosperous in the economic and social sense. The local features of the RES are due to the adaptation of global economic processes to the conditions and the desire of the local economy to survive in the conditions of global competition. The interaction of RES with the global economy should be considered from the point of view of the concept of glocalization.

For RES, this means that its entities can be integrated into the global market precisely due to the local features of the product.

Conclusions

Among the methodological principles of development of regional economic systems (RES), the following main ones can be distinguished:
— the principle of structure;
— the principle of network control;
— the principle of economic solidarity.

In the first period of post-war recovery of Ukraine [16] and the economic subsystems of the regions, it will be justified to use measures that represent the model of the mobilization economy, and which include the use of public procurement, placement of state orders at enterprises and other measures. This can be called "solidarity from above". In the future, as the economy enters a peaceful course, a transition is made to more flexible and less directive planning and management. At this stage, emphasis should be placed on organizing cooperation between enterprises in the region. This can be called "solidarity from below". Institutional support and information technology should be used to stimulate cooperation.

For effective planning and management of regional economic systems, it is important to develop means of their mathematical modeling, in particular simulation modeling.

Abstract

Development of regional economic systems is an important condition for ensuring the restoration of the national economy in the modern realities of resisting military aggression. Regional subsystems as interconnected components of the national economy must function harmoniously and ensure the success of achieving the goals of sustainability and viability of the entire system. This is the essence of the principles and approaches to ensuring the balanced economic development of territorial economic systems, including the State Strategy of Regional Development for the period 2021-2027.

The tasks of increasing the degree of cohesion and convergence are recognized as one of the key ones in both practical and fundamental aspects – in the works of many well-known researchers in the field of regional economy. The strategic goal of balanced and integrated development of regional systems in economic, social and other dimensions is laid down as the main one in the State Strategy of Regional Development of Ukraine, the post-war Recovery Plan, which brings the national goals of regional development closer to the pillars of European regional development policy. Ukraine's Recovery Plan accepted in July 2022, envisages achieving by 2032 the volume of accumulated investments of at least 750 billion dollars, annual GDP growth of at least 7%, the level of welfare of the population and human capital, as well as ease of doing business at the TOP 25 level in the world. It contains 15 programs that emphasize ensuring military and economic security in Ukraine, increasing the production of goods with a high share of added value, and creating conditions for decent work for the population of Ukraine. The key priorities of the Plan are directly or indirectly related to industrialization, which must take place on an innovative basis in order to implement the main tasks of national and regional development.

However, specific measures that are to ensure the implementation of the Recovery Plan programs, to ensure the development of regional economic systems, including achieving goals of the greater added value creation and planning the placement of manufacturing enterprises, were not developed. In order to implement the tasks of post-war recovery and further development of regional economic systems (RES) based on the effective use of available resources, it is necessary to develop a methodological toolkit, to define strategic principles for the construction and development of RES. The development of these principles is the purpose of the article.

The aim of the article is to determine the methodological principles of regional economic systems (RES) building and developing, to propose the measures on stimulation of cooperation between RES enterprises and methods of modeling RES for the purpose of planning and managing them. The purpose of the reasearch is to develop actual principles, mechanisms and tools for regional economic systems development taking into account post-war recovery requirements.

The article uses the methods of system analysis, statistical analysis, and mathematical modeling of economic processes. Research materials are represented by fundamental and applied results of scientific research in the field of regional economic systems development. The data on the enterprises proposed to be established are obtained by surveying similar enterprises, authorities and local governments. The article uses the results of the analysis of scientific publications indexed in the scientometric database Scopus on the subject of cooperative management of the regional economic systems development. The theoretical base of the study includes the analysis of 16 sources listed in the references. The main principles of construction and development of regional economic systems (RES) have been identified. The management of RES from the point of view of control theory is considered. The peculiarities of the operation of RES in the period of post-war reconstruction are indicated.

The concepts of "solidarity from below" and "solidarity from above" were introduced. An analogy is drawn between the management of the RES and the coordination of the activities of enterprises within the framework of the CPFR strategy. The means of stimulating cooperation in the RES, in particular institutional mechanisms and information technologies, are considered. A simulation model was built using the iThink program. The functioning of regional economic systems (RES) should proceed in accordance with three main principles: 1) the principle of structurality; 2) the principle of network management; 3) the principle of economic solidarity.

According to these principles, the construction and development of RES should take place. From a practical point of view, this means the need to coordinate the activities of economic entities for the purpose of cooperation, it means the possibility of planning economic processes and managing them. For the planning and management of RES, it will be appropriate to develop means of their mathematical modeling, in particular simulation modeling.

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