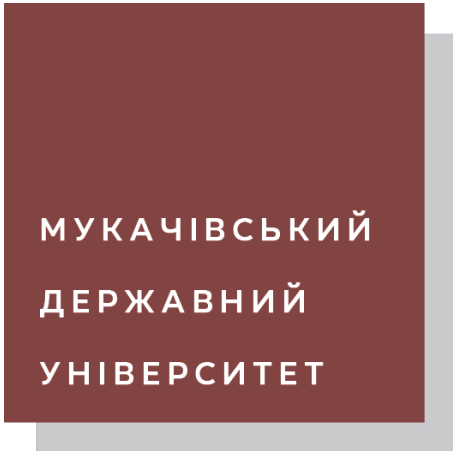


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Methodology for Rationalising the Distribution of Limited Material Resources Considering the Importance and Initial Adequate Supply of Facilities

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Abstract. The organisation of resource support for the needs of the Armed Forces of Ukraine is an important daily task related to the distribution of material resources for their intended purpose. If there is a sufficient resource base and the factors of time, speed, and priority of delivery of funds are secondary, resource support is carried out according to the principles “if necessary” and “if possible”. However, the practices of resource support for the needs of the Armed Forces of Ukraine considering the limited resource capabilities of the national economy and other similar tasks, as a rule, demonstrates the necessity of acting in the conditions of quantitative and qualitative restrictions of the resource base. Moreover, in the conditions of requirements for reducing the time of implementation of resource support, considering the priority of resource assignment objects and different levels of their initial resource provision. The purpose of this study is to find the best, rational, and even optimal distribution of resources for certain characteristics in three types of business conditions: certainty, uncertainty, and risk in managerial decision-making. Based on the analysis of available methods of nonlinear programming in distribution problems, proceeding from the condition of maintaining mathematical correctness and accessibility to practical use, the study presents the procedure for applying the maximum element method. The proposed approach to optimising the distribution problem is considered on the example of possible distribution options for equally efficient resource supply between the resource supply facilities. The options differ in the values of the importance of objects and the levels of initial supply in relative units at the time of decision-making on the allocation of resources upon providing resources for a certain final management task. The methodology of this study can be used in planning and decision-making related to the distribution of resources in organisational systems of military and civil administration, considering the importance and initial state of adequate supply of destination facilities in case of limited capabilities of the resource manager

Keywords: resource provision, priority of destination objects, rational allocation of resources, maximum element method, planning

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Introduction

The foundations of the state's defence capability and military security are created by its armed forces. The combat readiness and combat capability of the Armed Forces of Ukraine are largely dependent on the quantitative and qualitative level of their supply and technical equipment. The activities of state and military administration bodies related to the technical equipment of the Armed Forces and other law enforcement agencies are performed through the implementation of the national military-technical policy. Therefore, the military-technical policy of the state is interpreted as a directed and coordinated activity of state authorities and military administration, based on the system of conceptual opinions adopted in the state regarding military-technical support for the national defence and military security. The military-technical policy is aimed at practical solutions to the problems of providing the Armed Forces, other troops and military formations with weapons, military and special equipment, ammunition and property, and the development of the technological capability of the national military-industrial complex. The quantitative and qualitative composition of weapons and military equipment created in the process of implementing national programmes for the development of the Armed Forces is determined by the state and capabilities of the national economy, technological, production engineering potentials of the industry. For the purposes of this paper, the capabilities of the national economy to supply the Armed Forces of Ukraine mean its ability to meet the needs of the Armed Forces, maintain and develop weapons systems and their comprehensive support by maintaining and restructuring the military-industrial complex and developing an R&D and manufacturing base for the production of modern and promising weapons and military equipment.

The main tool for conducting military-technical policy is the rational use of the national economic capabilities, the rational distribution and redistribution of financial and material resources allocated by the state between various spheres of the military economy, the main areas of which are as follows:

- technological, with the creation of new and modernisation of available weapons and military equipment;
- manufacturing, related to the production of weapons and military equipment and military property;
- logistics, the content of which is the creation and maintenance of the necessary infrastructure and reserves for the functioning of troops (forces) in peacetime and wartime;
- ensuring the mobilisation readiness of industry and other economy sectors.

Resource support for the implementation of military-technical policy is provided from two groups of resources:

- resources allocated for ensuring the life and combat readiness of the Armed Forces of Ukraine;
- resources aimed at developing the economy sectors that produce both military products and social and economic products in the interests of the Armed Forces.

The main types of resources for ensuring military-technical policy include material (material and technical), human, and financial resources. Recently, information resources have also been classified in the above group. Providing military-technical policy with material resources is the process of supplying the Armed Forces of Ukraine with weapons and military equipment, ammunition, fuel and lubricants, clothing, medical, technical property, etc. At the same time, the military-industrial complex is equipped with high-tech materials and raw materials.

The continuous complication of modern weapons and military equipment is conditioned upon many objective reasons and leads to a considerable increase in their cost. This increases the importance of economic factors, the cost of military products, comparing with purely military factors when making appropriate decisions on the vectors of military construction in general and on the development vectors of the Armed Forces of Ukraine and their weapons systems, on the rationality and validity of defence spending. The development of means of supplying the Armed Forces, primarily complex weapons systems, is beginning to be dominated by the economic feasibility of using defence spending, the priority of economic factors, comparing with military-strategic, increasing attention to the effective use of the capabilities of enterprises of the military-industrial complex and the national economy in general to solve defence problems. The measures carried out in the organisation of resource supply for the needs of the Armed Forces of Ukraine include measures related to the distribution of material and technical supplies for military facilities. If the base for collateral is sufficient, and the factors of time, speed, and order of delivery of funds are of secondary importance, supply can be provided "if needed" and "if possible".

The theory and practice of ensuring the performance of tasks, including resource support, of the troops (forces) of the Armed Forces of Ukraine considering the limited resource capabilities of the national economy [1-3] clearly indicate that it is usually necessary to act in conditions of certain resource restrictions, and, moreover, in conditions of strict time requirements for the implementation of resource support, factoring in the importance of objects of the intended purpose of resources, different levels of their initial supply and legislative framework. Thus, the *purpose of this study* lies in finding the best allocation of available limited resources in predictable and unpredictable conditions for managerial decision-making.

Literature Review

The practice of resource support has demonstrated that as a rule, for most software tasks, restrictions on resource support factors, relationships between resource consumption objects are nonlinear in nature, and therefore nonlinear programming methods are used to solve problems of this class.

The analysis of mathematical methods used to solve problems of limited resource allocation, namely nonlinear programming methods, and the condition for maintaining mathematical correctness and accessibility to practical use among practitioners, allowed focusing on one of the numerical methods of nonlinear programming [4], namely the maximum element method [5-7]. Thus, the study of Y.M. Cheng and C.K. Lau evaluates the fundamental assumptions and limitations of stability analysis and computer modelling methods, namely upon applying the maximum element method [5]. The best developments of Ukrainian researchers "consider mathematical methods for studying economic processes under the influence of random factors, mastering which will allow systematising the knowledge and practical skills in economic and statistical modelling and forecasting" [8]. The fundamentals of optimal control theory, which are used to solve the problem of limited resource allocation and its application in the study of economic and mathematical models, are described in the study of V.S. Hryhorkiv [9]. Systematic coverage of calculations and matrix algebra, probability, optimisation, and dynamics with an emphasis on intuitive argument and problem-solving is covered by M. Pemberton and N. Rau [10]. Examples of practical solutions to problems, namely those related to the allocation of a limited resource, are given in the developments of E. Dowling [11]. The third chapter describes the theory of optimal control using linear algebra, differential and integral calculations, nonlinear programming, differential and difference equations, and calculus of variations. It also offers a brief overview of basic algebra for practical application to everyday economic problems and business situations.

The study of N. Boyko et al. proposes an approach to analysing the behaviour and predicting the location of an object for the following month using clustering algorithms [12]. The study also considers the problem of finding associative rules. The authors used scalable Apriori algorithms to find the best rules. At the same time, the problem of the search for associative rules that could find and describe patterns in large data sets is considered, which is advisable to use upon rationalising the distribution of limited material resources, considering the importance and initial state of supply of military facilities [12]. Furthermore, the study presents shortcomings concerning the problem of inaccuracy and inconsistency of data with real conditions, which affects the feasibility of applying associative rules to search for patterns in processes.

The study [13] provides the ways to improve production and economic systems to increase the efficiency of functioning of economic facilities and achieve high, final results of activity based on the rational use of resources of production activities of the enterprise. It is determined that the main purpose of resource management for enterprises is their optimisation. The study substantiates the

importance of determining the optimal need for resources and ensuring the structure of sources of its formation and use for the effective performance of an individual enterprise. The mathematical models and methods proposed in the paper [14] constitute effective mechanisms for forecasting, synthesis and analysis, and management support in the relevant areas of economic application. The developed methods and models are brought to practical implementation in the form of software that are reliable tools for solving problems of business forecasting, assessment and management of the development of economic processes and systems. The study [15] investigates the essence and significance of using methods of economic and mathematical modelling in managing the development of economic systems at the macro level using a systematic approach, and proposes approaches to ensure the adequacy of the development of economic and mathematical models that allow obtaining forecast values of the necessary indicators.

Materials and Methods

These tasks relate to the problems of choosing the optimal X_i option from a certain set X of possible options, $X_i \in X$. Each solution option X_i is a vector of controlled variables. This vector uniquely defines some final result with a quantitative estimate, which mostly corresponds to the value of the formed (selected) objective function. Such problems are solved by mathematical programming methods, which contribute to the choice of a solution that provides the maximum (minimum) value of the objective function of the effect.

The maximum element method belongs to gradient methods. Its main advantage is that it solves problems with numerous variables n reduced to a sequential solution of n tasks with a single variable. According to the algorithm of the method, only one unit of a discrete resource is distributed at each arbitrary step of the optimisation. This means that on each t -th iteration step ($t=1, \dots, d$), a single increment is provided ($\Delta X_i=1$) to only one i -th variable of the optimal vector $X_0 = \{x_i^0\}n$, which is an option of allocating the homogenous resource. After a finite number of steps d , which is equal to the number of units of the n resource, equal supply distribution, the entire resource N is optimally distributed among consumers.

In general, the problem statement can be formulated as follows. The task is to find the optimal vector $X_0 = \{x_i^0\}n$, which directs the target function (1):

$$F(X) = \sum_{i=1}^S F_i(x_i) = \sum_{i=1}^S A_i(1 - \varepsilon_i^{x_i}) \quad (1)$$

to the maximum, with linear constraints on its components (2):

$$\sum_{i=1}^n x_i \leq N \quad (2)$$

and additional conditions (3):

$$\left. \begin{array}{l} x_i \in \{0, 1, \dots, N\}, \\ 0 \leq (\varepsilon_i = 1 - \omega_i) \leq 1, \\ A_i > 0, \end{array} \right\} i = 1, \dots, S \quad (3)$$

After opening the parentheses, one gets (4):

$$F(X_0) = \max_x F(X) = \sum_{i=1}^S A_i - \min_x \sum_{i=1}^S A_i \varepsilon_i^{x_i} \sim \min_x \sum_{i=1}^S A_i \varepsilon_i^{x_i} \quad (4)$$

That is, the task of maximising the objective function $F(X)$ is equivalent to the function minimisation problem (5):

$$\bar{F}(X) = \sum_{i=1}^S A_i \varepsilon_i^{x_i} \quad (5)$$

To solve the problem of resource provision using the method of the maximum element, the former can be formulated as follows. There is a certain amount of resource N , which, to perform resource supply tasks, must be distributed among several $i=1, \dots, S$ resource-consuming facilities. Each of the facilities has a relative importance (weighting factor) A_i from the standpoint of participation in the performance of the final task for which resources are supplied (e.g., tasks for mobilisation training, bringing to combat readiness, etc.). Resource N can come from a higher authority of management or in separate identical batches (units) X_p or in its entire volume, but can be consumed by facilities as separate batches X_i . Each batch (unit) of the resource ensures that the facility performs the final task with probability $\varpi_i = 1 - \varepsilon_i$, where $\varepsilon_i = 1 - \varpi_i$ is the conditional probability of not supplying the resource to the facility. It is necessary to find a method of distributing resource supply funds by resource-consuming facilities, where the maximum distribution effect is achieved (total resource usage, time of use, speed of use). Therewith, ϖ_i can be interpreted as the relative need for resource supply of the final task and determined according to the following formula (6):

$$\omega_i = \frac{W_i}{\sum_{i=1}^S W_i} = \frac{T_i}{\sum_{i=1}^S T_i} = \frac{V_i}{\sum_{i=1}^S V_i} \quad (6)$$

where W_i is the required task volumes for i -th supply facility; T_i is the required time to complete the task on the i -th supply facility; V_i is the required pace of completing the task on the i -th supply facility.

Maximising the overall effect $F(X)$ is equivalent to maximising the average value based on one of the i -th resource batch N , that is (7):

$$\max_x F(X) \sim \max_x \left\{ \frac{F(X)}{N} = v(X) \right\} \quad (7)$$

The average effect $v(X)$ based on one of the N will be the maximum supply amount if at each stage of the process one of the active supplies is assigned to the supply facility i , where the effect increment at this step (Δ_i) is maximum.

Such an algorithm for allocating a resource across facilities to achieve the maximum effect can be considered justified, since each of the functions $F_i(x_i)$ is convex upwards and forms a descending sequence of effect increments (Δ_i) from the influence of each subsequent batch (8):

$$\begin{aligned} F(x_i) &= A_i(1 - \varepsilon_i^{x_i}) = A_i\omega_i + A_i\varepsilon_i\omega_i + \dots + A_i\varepsilon_i^{x_i-1}\omega_i^* = \\ &= \Delta_{1i} + \Delta_{2i} + \dots + \Delta_i = \sum_{k=1}^{x_i} \Delta_{ki}, \quad \Delta_{ki} = A_i \varepsilon_i^{k-1} \omega_i \end{aligned} \quad (8)$$

hence it allows the resource to be distributed in the same minimum (single) portions on one side, and due to the same type (uniformity) of batches, no mutual replacement of any two of their units is required.

After covering the approach to solving the problem, it remains to determine the expression for calculating the increment value Δ_i of the objective function, which it obtains on an arbitrary t -th stage of the optimisation. By the time of appointment of the x -th resource unit on the t -th first step of the process, $(t-1)$ units have already been distributed, and the i -th facility is supplied with certain probability $P_i^{(t-1)}$ ($i = 1, \dots, S$), i.e., at this point, the value of the objective function can be written as follows (9):

$$F_{t-1} = \sum_{i=1}^S A_i P_i^{(t-1)} \quad (9)$$

After the appointment of the x -th unit (resource) to l -th facility ($l=1, \dots, S$), the current value of the objective function will increase only when the l -th facility increases the effect and will be as follows (10):

$$F_t = \sum_{i=1}^S A_i P_i^{(t-1)} + A_l (1 - Q_l^{(t-1)} \varepsilon_l) \quad (10)$$

where $Q_l^{(t-1)} = 1 - P_l^{(t-1)}$ is the probability of failure in terms of resources of the l -th object to the appointment of the t -th batch of means; $\varepsilon_l = 1 - \omega_l$ is the conditional probability of non-provision of the l -th facility in terms of resources be the t -th batch.

Adding and subtracting agent $A_l P_l^{(t-1)}$ from the right-hand side of Eq. (9) and considering Eq. (10), one obtains as follows (11):

$$F_t = F_{t-1} + A_l (1 - Q_l^{(t-1)} \varepsilon_l) - A_l P_l^{(t-1)} \quad (11)$$

The increment after elementary transformations is written as follows (12):

$$\Delta_l = F_t - F_{t-1} = A_l Q_l^{(t-1)} \omega_l = A_l^{(t-1)} \omega_l, l = 1, \dots, S \quad (12)$$

If A_l is the initial weight coefficient of the facility, then $A_l^{(t-1)} = A_l Q_l^{(t-1)}$ is its weight after distribution $(t-1)$ of supply units.

The algorithm of sequential actions (steps) of optimising the resource allocation based on the selected maximum element method can be presented in the form of the flow-chart presented in Figure 1.

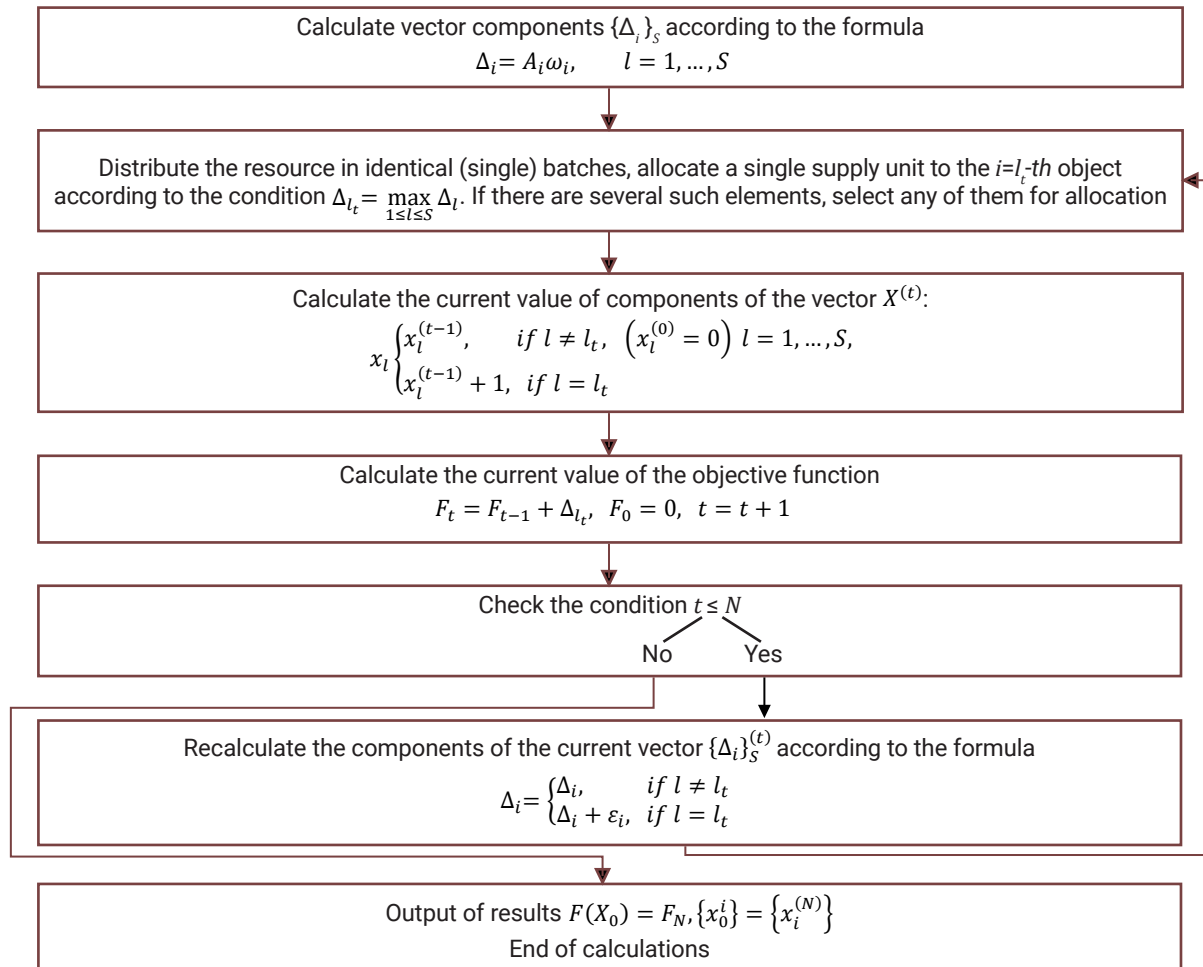


Figure 1. Flowchart of allocation of material resources (supplies) considering the importance and initial adequate supply of military facilities

According to the algorithm of the method, only one unit of a discrete resource is distributed at each subsequent step of the optimisation. This means that on each t -th iteration step ($t=1, \dots, d$), a single increment is provided ($\Delta X_i=1$) to only one i -th variable of the optimal vector $X_0 = \{x_i^0\}_n$, which constitutes an option of allocating the homogenous resource between n consumers. After a finite number of steps d , which is equal to the number of units of the n resource, the entire resource is optimally distributed among consumers.

To distribute a multi-efficient resource using the proposed methodology, supply resources should be divided into equal batches in terms of efficiency (productivity, and other qualitative characteristics). The resource should be distributed by supply facilities in batches. At the same time, the sequence of batch changes should be carried out towards reducing the efficiency (productivity, quality capabilities) of the resource's funds. There may be situations when for all supply facilities the volumes of tasks must be not lower than admissible for obligatory maximisation of target function.

In such cases, the above algorithm allows justifying the amount of supply resources required to achieve the

goal of the final task. In this case, the initial number of batches of resource N is not limited, and the resource allocation continues until the total volume of tasks for all supply facilities meets the specified limit. The number of batches of the resource that ensures the achievement of the goal is assumed to be equal to the number of distribution steps, that is, $N=t$.

Results and Discussion

The proposed approach to optimising the distribution problem is considered on the example of three possible distribution options for equally efficient resource supply between five resource supply facilities. The options vary in different priority values A_i of objects on a ten-point scale of the final resource supply and different levels of initial supply in relative units (percentages) at the time of decision-making on the allocation of resources upon supplying resources for a certain final management task. It is assumed that data on the priority and level of initial adequate supply of resources are determined either by a group of expert officials or by a decision-maker. The solution result for the first option is presented in Table 1.

Table 1. The first option of rational distribution of 7 resource means between 5 facilities

Step of the sequential resource allocation $t=1, \dots, N$	Resource allocation facilities $i=1, \dots, S$					<i>Objective function F_t^1 of effect of using the resource</i>
	1	2	3	4	5	
	Importance (priority) of the facility, weight coefficient A_i					
	2	6	10	4	8	
	Resource availability (facility status) indicators ω_i					
	0.6	0.5	0.5	0.4	0.6	
Increment Δ_i of effect of using a resource for a facility i , Δx_i						
1	1.2/0	3/0	5/1	1.6/0	4.8/0	5
2	1.2/0	3/0	2.5/0	1.6/0	4.8/1	9.8
3	1.2/0	3/1	2.5/0	1.6/0	1.92/0	12.8
4	1.2/0	1.5/0	2.5/1	1.6/0	1.92/0	15.3
5	1.2/0	1.5/0	1.25/0	1.6/0	1.92/1	17.22
6	1.2/0	1.5/0	1.25/0	1.6/1	0.77/0	18.82
7	1.2/0	1.5/1	1.25/0	0.96/0	0.77/0	20.32
$\Sigma \Delta_i / \Sigma \Delta x_i$	0/0	4.5/2	7.5/2	1.6/1	6.72/2	20.32

At the first step (Table 1), the values of effect increments (Δ_i) are calculated as a product $A_i \omega_i$. The maximum increment of the effect at this step is given by allocating a resource supply unit to the third facility $x_3 = 1$, $\Delta_3 = 5$, $F_1 = 5$. The resource supply is not assigned to all other facilities at this step. At the second step, the effect increment values for all facilities, except the third, remain the same (they did not change at the first step), and when determining the effect increment for the third object, the conditional execution of the required volumes of tasks by one supply batch at the first step is factored in, that is, $\Delta_3 = A_3(1 - \omega_3)\omega_3$.

The maximum increment of the effect at the second step is given by allocating resources to the fifth facility $x_5 = 1$, $\Delta_5 = 4.8$. The value of the objective function is $F_2 = F_1 + \Delta_5 = 5 + 4.8 = 9.8$. Continuing to perform a consistent distribution of resource funds by collateral objects

in this fashion up to $t=7$, one gets the result of solving the problem using the maximum element method. At each step (Table 1), elements that are considered at every step of the resource allocation are highlighted in bold. The last line indicates the total effect for each facility and the total number of supply batches allocated to these facilities. For supply facilities that were not allocated funds, the total effect is zero.

Therefore, the maximum value of the objective function during the allocation of seven resources is $F_7 = 20.32$. At the same time, funds for collateral objects are distributed as follows: $x_1 = 0, x_2 = 2, x_3 = 2, x_4 = 1, x_5 = 2$. Therefore, the first object is not supplied at all, and this should be taken into account upon analysing the results of calculations performed.

The solution result for the second option is presented in Table 2 and the third option is presented in Table 3.

Table 2. The second option of rational distribution of 7 resource means between 5 facilities

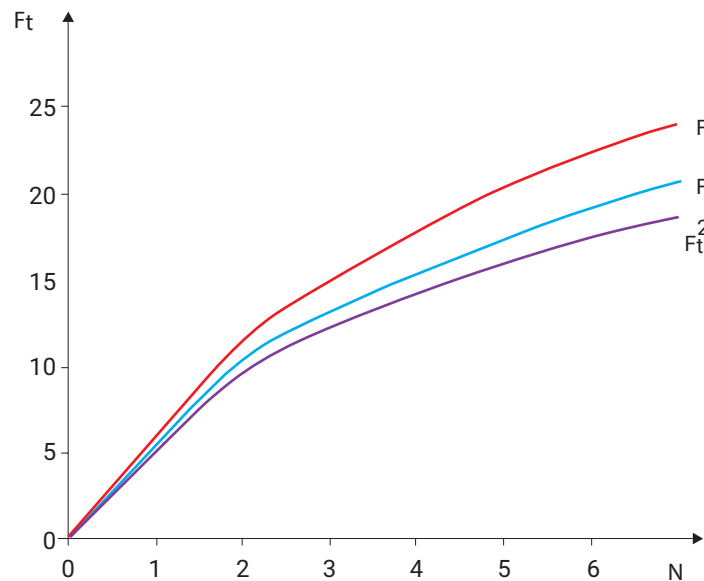
Step of the sequential resource allocation $t=1, \dots, N$	Resource allocation facilities $i=1, \dots, S$					Objective function F_t^z of effect of using the resource
	1	2	3	4	5	
	Importance (priority) of the facility, weight coefficient A_i					
	8	4	10	6	2	
	Resource availability (facility status) indicators ω_i					
	0.6	0.4	0.5	0.3	0.6	
Increment Δ_i of effect of using a resource for a facility i , Δx_i						
1	4.8/0	1.6/0	5/1	1.8/0	1.2/0	5
2	4.8/1	1.6/0	2.5/0	1.8/0	1.2/0	9.8
3	1.92/0	1.6/0	2.5/1	1.8/0	1.2/0	12.3
4	1.92/1	1.6/0	1.5/0	1.8/0	1.2/0	14.22
5	0.77/0	1.6/0	1.25/0	1.8/1	1.2/0	16.02
6	0.77/0	1.6/1	1.25/0	1.26/0	1.2/0	17.62
7	0.77/0	0.96/0	1.25/0	1.26/1	1.2/0	18.88
$\Sigma \Delta_i / \Sigma \Delta x_i$	6.72/2	1.6/1	7.5/2	3.06/2	0/0	18.88

Table 3. The third option of rational distribution of 7 resource means between 5 facilities

Step of the sequential resource allocation $t=1, \dots, N$	Resource allocation facilities $i=1, \dots, S$					<i>Objective function F_t^3 of effect of using the resource</i>
	1	2	3	4	5	
	Importance (priority) of the facility, weight coefficient A_i					
	2	6	10	4	8	
	Resource availability (facility status) indicators ω_i					
	0.5	0.4	0.7	0.8	0.6	
	Increment Δ_i of effect of using a resource for a facility i , Δx_i					
1	3/0	2/0	5.6/0	3.2/0	6/1	6
2	3/0	2/0	5.6/1	3.2/0	2.4/0	11.6
3	3/0	2/0	1.68/0	3.2/1	2.4/0	14.8
4	3/1	2/0	1.68/0	0.64/0	2.4/0	17.8
5	1.5/0	2/0	1.68/0	0.64/0	2.4/1	20.2
6	1.5/0	2/1	1.68/0	0.64/0	0.96/0	22.2
7	1.5/0	1.2/0	1.68/1	0.64/0	0.96/0	23.88
$\Sigma \Delta_i / \Sigma \Delta x_i$	3/1	2/1	7.28/2	3.2/1	8.4/2	23.88

The target functions of the general effect for the considered examples of resource distribution calculations depending on the priority and initial availability of destination facilities are presented in Figure 2. Evidently, each

objective function of the total distribution effect is an upward-convex curve that reflects the descending sequence of the increase in the effect from each subsequent supply batch arriving at the facility.


Figure 2. Objective functions of the overall effect of the three distribution options considered

Notably, the different values of the final and intermediate values of the objective functions depend solely on the initial conditions for each of the variants and do not indicate a greater or lesser comparative efficiency of a particular distribution variant.

The different quantitative nature of resource allocation (the sequence of distribution and the number of units of the received resource), depending on the importance (priority) and initial state of supply of the corresponding resource-consuming facility, is presented in the final table (Table 4). The nature of allocation, i.e., the sequence of supplying a resource

to the corresponding facility, is different and depends on the initial level of resource availability at the facility and the importance of the facility in performing the final task for which the resource supply is intended. If the total amount of the resource is inadequate, and it is in conditions of restrictions, the resource should be distributed in separate batches in a certain sequence determined according to the maximum effect algorithm. If the resource is sufficient, it can be allocated once, in batches equivalent in performance (efficiency), in the amount determined by the maximum effect algorithm under study.

Table 4. Final table of resource allocation depending on the importance and initial state of supply

Options for possible priority and initial state of supply of the resource supply facility	The sequence of resource allocation depending on the importance of the resource supply facility and the initial state of its resource availability							The total number of resource units received by each facility for each allocation option				
	facility number							facility number				
								1	2	3	4	5
First	3	5	2	3	5	4	2	0	2	2	1	2
Second	3	1	3	1	4	2	4	2	1	2	2	0
Third	5	3	4	1	5	2	3	1	1	2	1	2

Achieving the goal of allocation according to the selected mathematical apparatus allows performing sequential, alternate bringing of equivalent resource volumes in terms of efficiency (productivity) to one of the assigned facilities, considering their needs and priority in supply. The sequence of bringing the resource to facilities should be accompanied by a decrease in the dynamics of efficiency growth from the use of the resource. This indicates that the resource is correctly represented "according to the need and priority" of the destination objects. The considered approach to optimising the problem of allocating a limited amount

of resource can be extended not only to material and technical, but also to other types of resources, provided that the type of resource is adequately reflected by the corresponding unit of measurement. The approach can be considered as an accessible method for justifying management decisions when planning types of support for troops (forces). The summarising brief description of the proposed method of rational (optimal) distribution of material and technical means in conditions of a limited total resource is presented in Table 5.

Table 5. Characteristics of the methodology of optimal distribution of material and technical means in conditions of limited total resource

Resource type, supplied by the methodology	Material and technical, human, informational, financial
Possible tasks from the Resource Manager	Rational distribution of the available limited resource to perform the following tasks: material and technical support of troops (forces); mobilisation training of enterprises, sectors of the national economy; implementation of the resource manager programme
Purpose of allocation	Optimal distribution of a limited resource in terms of time, consumer needs, and final effect to achieve maximum effect in the final tasks of the resource manager
Selected mathematical apparatus	Methods of mathematical programming: optimisation methods of decision-making; methods of nonlinear programming
Applied optimisation methods	Method of the maximum element (increment of the objective function of the effect). Method of expert assessments for determining the needs (condition) of resource allocation facilities and their priority in the final tasks of the resource manager
The essence of the allocation organisation	Sequential, alternate bringing of equivalent efficiency (productivity) volumes (batches) of a resource to one of the assigned facilities, considering their needs and priority in performing the final (main) task of the resource manager
A way to maximise the overall effect of resource allocation	Achieving the maximum overall effect of a resource by alternately bringing it to the object where the maximum effect (local effect) of using the resource is achieved
Feature of organising the sequence of bringing resources to facilities	The sequence of bringing the resource to objects should be accompanied by a decrease in the dynamics of efficiency growth from the use of the resource. This indicates that the resource is presented correctly "as needed and prioritised" to effectively perform the final task of the resource manager
Purpose of the proposed methodology	Preparation and justification of planning and decision-making options related to resource allocation in organisational systems of military and civil administration

Conclusions

Thus, the study confirmed that the proposed methodology of optimising the distribution of equally efficient supply resources between several resource support objects allows considering different values of the priority of resource supply facilities on a ten-point scale and different levels of initial

supply in relative units at any time of resource allocation. At the same time, it was discovered that a prerequisite is that data on the priority and level of initial resource availability are determined by experts or a decision-maker. It is proved that it is the options for allocating available material and technical, human, information and financial resources,

considering the importance and initial state of supply of destination facilities in case of limited capabilities of the resource manager (and the national economy in general), that rationalise the implementation of such tasks as technical support and preparation for the actions of troops (forces); mobilisation training of enterprises of branches of the national economy; implementation of budget programmes, etc. It is summarised that the type of resource that is supplied, possible tasks from the resource manager, the purpose of distribution, the essence of the distribution

organisation, the method of maximising the overall effects of resource allocation and the features of organising the sequence of resource representation on facilities are decisive upon the application of the proposed methodology, the choice of optimisation methods and the appropriate mathematical apparatus.

The methodology can be applied in planning and decision-making processes related to the allocation of resources in organisational systems of both military and civil administration.

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**Методика раціоналізації розподілу
обмежених матеріальних ресурсів з урахуванням важливості
і початкового стану забезпеченості об'єктів призначення**

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Анотація. Організація ресурсного забезпечення потреб Збройних Сил України є важливим повсякденним завданням, що пов'язане з розподілом матеріальних засобів за об'єктами призначення. За умови достатньої ресурсної бази та другорядності чинників часу, швидкості, черговості постачання засобів, ресурсне забезпечення здійснюється за принципами «за потребою» і «за можливістю». Однак у практиці ресурсного забезпечення потреб Збройних Сил України з урахуванням обмежених ресурсних можливостей національної економіки, і інших подібних завдань, як правило, доводиться діяти в умовах кількісних і якісних обмежень ресурсної бази, і, до того ж, в умовах вимог до скорочення часу здійснення ресурсного забезпечення з урахуванням пріоритетності об'єктів призначення ресурсів, різного рівня їхньої початкової ресурсної забезпеченості. Метою статті є пошук найкращого, раціонального і, навіть, оптимального за певними ознаками розподілу ресурсів за трьома варіантами умов діяльності: визначеність, невизначеність і ризик у прийнятті управлінських рішень. На підставі аналізу наявних методів нелінійного програмування в задачах розподілу, виходячи з умови збереження математичної коректності і доступності до практичного використання, в статті наведено порядок застосування методу максимального елементу. Запропонований підхід до оптимізації задачі розподілу розглянуто на прикладі можливих варіантів розподілу рівно ефективних засобів ресурсу між об'єктами ресурсного забезпечення. Варіанти відрізняються значеннями важливості об'єктів і рівнями початкової забезпеченості у відносних одиницях на момент прийняття рішення щодо розподілу ресурсів у процесі ресурсного забезпечення деякого кінцевого завдання управління. Наведена в статті методика може застосовуватись у процесі планування та прийняття рішень, пов'язаних із розподілом ресурсів в організаційних системах військового та цивільного управління з урахуванням важливості та початкового стану забезпеченості об'єктів призначення у разі обмежених можливостей розпорядника ресурсу

Ключові слова: ресурсне забезпечення, пріоритетність об'єктів призначення, раціональний розподіл ресурсів, метод максимального елементу, планування

Development Trends of the Securities Market in Ukraine

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Abstract. The relevance of the research is due to the rapid development of the securities market. Financial instruments have been improving in Ukraine for a long time, new intermediaries and market participants have been appearing. Consequently, there is a growing need for effective regulation of changes that are mainly intra-economic and can affect various spheres of public life. The work aims to identify modern features of the functioning of the Securities Market on the territory of Ukraine. Taking into account the interdisciplinarity of this topic, analysis, synthesis and induction were chosen as the leading research methods. These systems of procedures were combined primarily to form ideas about the relationship between economics and law. In this context, the first method contributed to the objectification of the properties of securities; thanks to the synthesis, it was possible to draw complete conclusions and generalisations about the directions of development of the relevant market. At the same time, the induction was used to obtain a general conclusion about the possibilities of regulating the securities market. The article provides an essential description of the concepts of "securities market" and "stock market". In addition, the structure of the financial market was determined: the main organisers of trade and its participants. The main laws were also presented in the field of legal regulation of the securities market of Ukraine and the EU. Finally, the development was justified of the Ukrainian stock market in the context of European integration processes. The article materials are of theoretical and practical importance for bank employees, financial management specialists, credit brokers, auditors and insurance agents. Due to the availability of a description of the international practice of using financial instruments, the study may be of interest to representatives of public authorities and educational organisations. However, the approximation of the legislation of Ukraine in the field of securities circulation to European standards will remain a controversial issue for each of these groups of people

Keywords: stock market, capital, financial services, investment, Europeanisation

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Introduction

The securities market is an integral part of the financial market of any country, which is also sometimes called the stock market. By its economic origin, the securities market belongs to the group of specialised functional markets, which was formed in the second half of the twentieth-century under the influence of the development of credit relations and Joint-Stock Ownership. Historically, the functional purpose of the securities market has been the promotion of investment capital from those who have free financial resources to those who feel such a need. That is, the securities market is an effective mechanism for redistributing investment resources and transforming savings into investments in a market economy [1; 2].

The formation of the securities market and the specifics of its development have been studied by many foreign and Ukrainian economists who have formed their approaches to this issue. So, for example, the study of theoretical and practical problems of integration of the state stock market into the world community was carried out by such scientists as N. Chaudhry, D. Roubaud, W. Akhter and M. Shahbaz [3]. Analysis of the definitions of "securities market" and "stock market" given in works of C. Bourne [4], A.M. Syed and I. A. Bajwa [5] do not find significant differences that would indicate fundamental content aspects of their essence. They show an almost identical approach to understanding the securities market as a set of economic relations regarding the issue and circulation of securities – a specific commodity sold in a separate segment of the financial market. Another work demonstrates the securities market as a set of economic relations related to the production, turnover and redistribution of securities to ensure the distribution of free funds between different economic entities [6]. However, despite the transparency of these concepts, other economic categories also need to be explained, in particular, this applies to securities as a separate object of economic relations.

In the most general sense, security is a document that embodies some of its owner's rights against the issuer of that document. This opinion is shared by L. Macíková, who adds that security is a record of the owner or claim against the issuer of security [7]. However, according to B. Chovancová security belongs to the associate property and other rights of an authorised person defined and established by the Securities Law [8]. In general, there is a double view of securities in foreign encyclopedic literature. Some authors note that security is a certain value of an asset that allows converting money into capital through its functioning in the Financial Market [9]. A set of interactions between economic entities related to the issue and sale of securities can form a securities market. If we analyse this from a legal point of view, we can see that the regulatory aspects of regulating relations are ignored between investors and issuers. For example, T. Tavor and Sh. Teitler-Regev see this as a serious drawback, since force majeure events (technological and natural disasters, terrorist acts, economic

recessions and ascents, etc.) can hinder the processes in the stock market, and therefore there will be requirements for its legal significance [10].

Undoubtedly, these studies have made a significant contribution to the development of the concept of managing economic processes, but the problem is still relevant of functioning and prospects for the development of financial sectors in Ukraine. That is why the paper focuses on the specific problems of the Ukrainian securities market and attempts to determine its effective model.

Materials and Methods

This scientific article used various methods of scientific research: theoretical methods (analysis, synthesis and induction) and empirical (comparison). With the help of analysis, it was possible to decompose the object under study into separate parts and determine the properties of this object. As for the synthesis, it was used to represent basic approaches to the formulation of the theoretical essence of economic categories. Further, general conclusions were obtained on the regulatory and legal regulation of the securities market in Ukraine using the inductive method. However, such a generalisation is incomplete and its truthfulness is problematic. Therefore, a combination of general research methods was used, which were later supplemented with a comparison. The last cognitive operation helped to group the objects of research. We are talking, in particular, about the provisions of the national currency legislation on investing in stock assets of Ukraine.

The consistent transition from a holistic description of the securities market to finding out its structure and participants was the initial stage of research. At this stage, the specifics of the purchase and sale of securities were not only recorded but also the relationship between them was established. The securities market was then considered as part of the capital market or financial market. As a result, several provisions became the methodological basis of the study. The first of them is that the securities market is not at its full power in Ukraine due to some problems with public confidence in the financial market and the narrow range of instruments. The second is based on the idea that effective involvement of the Ukrainian securities market in the EU's international financial and investment processes is impossible without liberalising capital flows. Therefore, the problems of legislative regulation and the lack of public confidence in the financial market were the key issues when analysing trends in the securities market development.

It is worth noting that most Ukrainian authors focus their attention on the general topic of the functioning of the stock market, but neglect the legislation regulating the behaviour of market participants [1; 2]. Such studies allow us to understand better the reason for the low activity in the market of individuals, who are mainly the main investors. However, this is not enough to form ideas about the direction of development of a special sphere of market

relations. In this regard, the text of the article was structurally divided into separate sections and paragraphs after a preliminary definition of the three stages of the study. As mentioned earlier, the structure of the stock market was analysed and its main participants were identified. At this stage, the personal interest aroused the need for efficiency and fairness of relations in the securities market, so the study of relevant regulatory practices of Ukraine and the EU continued. The second stage of the study involved processing statistical data on the current state of the securities market. Thanks to this, it was possible to record a partial repetition of trends in the development of the European market, which emphasizes Ukraine's dependence on the development directions of international financial institutions. Finally, recommendations were formed to improve the efficiency of the securities market in Ukraine. Thus, the results of each stage correlated with the capabilities of the state apparatus as a means of overcoming the identified shortcomings in the country's financial sector.

Results and Discussion

In the modern conditions of the development of scientific literature, several normative approaches have been formed to determine the economic content of the concepts of "securities market" and "stock market". According to Article 2 of the Law of Ukraine "On Securities and Stock Market", these concepts are considered equivalent, since "the stock market (securities market) is a set of participants in the stock market and legal relations between them regarding the placement, circulation and accounting of securities and derivatives" [11]. We agree with this approach and emphasize that securities are a reflection of tangible or monetary funds.

It is worth noting that the terms "securities market" and "stock market" are mainly used as synonyms in the Ukrainian economic literature. However, there are some works where there is no interpretation of the concept of "stock market" at all, although this economic category is widely used abroad [12]. In particular, some researchers consider the stock market only as a market for classic long-term exchange-traded securities, including stocks and bonds [12]. In addition, Ukrainian scientists use completely different approaches to their explanation, so the definitions of "securities market" and "stock market" have an unbalanced content. A detailed study of the regulatory framework for the securities market opens up prospects for solving this problem. Here it is appropriate to pay attention to the fact that the legal theory of sources of knowledge differs from the economic one, but not entirely without exceptions. Thus, proponents of the normative approach characterise the securities market as a kind of mechanism by which it is possible to establish legal and economic relations between participants in the general financial market [13]. Nevertheless, the research results indicate significant shortcomings in the functioning of the Ukrainian securities market. For example, one of the problems remains the attitude of the National Bank of Ukraine (NBU) to operations with foreign

currency. This is primarily because the state regulation is based on the norms of the early 1990s and shows a fixed exchange rate policy, limiting the outflow of foreign currency from the country. As a result, there is a slowdown in operations with securities – if a resident wants to purchase a security of foreign origin that is not traded in Ukraine, he must obtain an individual currency license from the NBU. To do this, they must provide a purchase and sale agreement, a certificate of securities in a seller's account, and a certificate of money in a resident buyer's account. Under these circumstances, the money and security will be "frozen" for the entire period of obtaining a license, which in practice is more than 30 days. As a result, trading in foreign securities in Ukraine is possible only through a dealer with a currency license.

In general, due to the weakness of Ukrainian legislation, commodity and financial exchanges have been misused for many years, causing significant damage to the country's economic interests. Commodity exchanges were often part of tax evasion or tax optimisation schemes [14]. In this regard, the state should provide financial and commodity markets with reliable exchange infrastructure for organised trading and high-quality financial instruments. At the legislative level, the concept of netting is already being introduced – a system of both pre-trade and post-trade reporting on operations with underlying assets; a procedure for authorising key infrastructure facilities and supervising their activities to counteract manipulation and other abuse in the markets is being introduced. This mechanism is introduced following the Law of Ukraine "On Capital Markets and Organised Commodity Markets" (Draft Law No. 2284 on amendments to certain legislative acts of Ukraine concerning simplification of attracting investment and introduction of new financial instruments), which was adopted by the Verkhovna Rada of Ukraine on June 19, 2020, and signed by the President of Ukraine on August 12, 2020 [15]. The liquidation netting procedure will allow the parties to derivative contracts to pay off if the partner defaults or insolvency occurs [16]. The main elements of such a new infrastructure of capital and commodity markets will be the central counterparty, repository and operators of trading platforms.

In the course of the analysis, it was found out that the economic development of the securities market in modern conditions implies the presence of other participants. For example, the above-mentioned NBU belongs to professional participants in the securities market, because it not only distributes government securities but also independently conducts operations for the purchase and sale of securities, acts as a dealer; creates a secondary securities market; performs the functions of a depository, clearing and settlement centre, that is, remains a specialized organization for accounting, storage and settlement of operations with government securities [17]. Other banking institutions regulated by the NBU are also active participants in the stock market, so the National Securities and stock market Commission should regulate them. These banking institutions

also form financial groups with non-bank financial institutions that are regulated by the National Commission regarding the sphere of financial services markets. However, the powers of these bodies are very diverse, and therefore it is difficult to monitor participants in these sectors of the financial market. Given these circumstances, the reform of the securities market should take place together with the change of the banking system, because banks occupy a central place here and they are allowed to combine ordinary banking operations with operations on the stock market.

Analysis of recent studies and publications that have started solving economic problems has shown that the securities market has just begun to form in Ukraine and is slowly gaining momentum. Thus, the current situation on the Ukrainian stock market is characterised by a low level of liquidity, low capitalisation of listed companies, the dominance of domestic government bonds of Ukraine (government bonds), as well as the main trading volume in the OTC segment (more than 60% in 2019). Prime Minister of Ukraine Denis Shmygal called a crime the lack of a full-fledged stock market in the country in the 30th year of independence [18]. According to local media, the government intends to restart the Securities Market by 2023 [18]. By this time, the capitalisation of issuers on Ukrainian exchanges was at a record low UAH 1.61 billion (approximately 59 million USD). For example, this figure was 3 37.6 trillion USD in the United States in 2019 and 151.62 billion USD in neighbouring Poland. The volume of securities issued in Ukraine in 2020 amounted to UAH 113.4 billion, which is 79 million less compared to 2019. Companies issued shares for UAH 32.98 billion, bonds for UAH 32.95 billion; for 9.4 million USD and 3 million EUR in foreign currency. The issue of local loan bonds amounted to UAH 3.9 billion (UAH 3.1 billion more than in 2019), the issue of mutual fund investment certificates – UAH 5.05 billion, which is UAH 7.9 billion less than in 2019, the issue of CIF shares – UAH 38.52 billion (UAH 13.53 billion more than in 2019).

Based on the capitalisation indicators of European stock exchanges, comparing them with the PFTS of Ukraine, we once again state a negative trend in the Ukrainian market. In particular, was by LSE (London Stock Exchange) took 1st place in 2019 with 3.86 trillion euros, Euronext – 2nd place with 3.4 trillion euros, and Deutsche Börse – 3rd place with a capitalisation indicator of 1.9 trillion euros [19]. In the end, the PFTS indicator of Ukraine was then equal to 0.17 trillion euros, although it serves more than 85% of the total trading volume, while the Ukrainian Stock Exchange (USE) is about 14 % [20]. The PFTS Stock Exchange is the leading stock exchange in Ukraine, which was legally considered a trading system for a long time (until 2006), hence its name is the first stock tradinsecurities market (leading investment companies and banks) were members of the stock exchange. The PFTS is a corresponding member of the World Federation of Stock Exchanges and a member of the International Association of exchanges of the CIS countries. At the end of 2015, its shareholders were

37 Ukrainian banks, 30 individuals and 77 legal entities – non-banking institutions [21]. Although the PFTS actively conducts securities auctions, some problems of Ukrainian stock exchanges remain unresolved.

The problems of the current state of development of the securities market are mainly caused by the adoption of the Law of Ukraine of June 19, 2020, No. 738-IX “On Amendments to Certain Egislative Acts of Ukraine Concerning Simplification of Attracting Investment and Introduction of New Financial Instruments” [15]. This Act regulates procedural issues related to the issue and placement of securities, including domestic bonds. However, the implementation of this law does not guarantee the full participation of foreign investors in the purchase of Ukrainian securities. In addition, instead of stock exchanges, the bill introduces two types of markets – a regulated market with more stringent requirements, which will ensure centralised execution of transactions and a less regulated market for alternative trading platforms (Multilateral Trading Facilities (MTFs) and Organized Trading Facilities (OTFs) [22]. As mentioned above, there will be a central counterparty on the territory of Ukraine, which will reduce the risks of non-fulfilment of contracts between counterparties. Further changes in the Ukrainian securities market will be coordinated with European standards, including Directive 2014/65/EC (MiFID II) [23] and Regulation (EU) No. 648/2012 (EMIR) [24]. It is not about copying the acts, but about adapting them to Ukrainian realities, taking into account all the features of the Ukrainian market.

Over time, the Securities trader will be transformed into a full-fledged investment company model, which is widespread in Europe, and will get more business opportunities. Licensing will be carried out according to the principle: less responsibility – fewer requirements for obtaining a license, more responsibility – more requirements. The investment company will be able to use so-called related agents in its activities, who will act on behalf of, under the control and at the expense of such a company. In addition, the “know your client” model will be introduced for all financial institutions, which in Europe is used by all financial market participants – banks, exchanges, and other companies working with private money. This practice will help to resist fraud, embezzlement, money laundering and financing of illegal operations. The establishment of clear obligations accompanies legal regulation of the securities market when participants in financial and legal relations are strictly recommended to choose a certain behaviour option. The efforts of the European Economic Community are aimed at bringing together the legislative framework of member states and liberalising the International provision of investment services. Legal regulation of the securities market in the EU countries is implemented through a set of elements such as regulation, supervision and enforcement measures [25].

Several years ago, the process of reviewing all current legislation of Ukraine in the field of functioning of capital

and goods markets and adapting it to EU standards was launched. First, experts focused on key European legislation, such as MiFID, MIFIR [26] and EMIR [27]. They are mandatory for all EU member states, as well as the countries of the European Economic Area.

The start of the integration process was marked by the coronavirus pandemic, which is still the subject of discussion for many foreign researchers. There is reason to believe that the coronavirus has had a significant impact on the global economy. Changes in the global financial market are well described in the literature [28], as well as in the literature devoted to regional financial markets [29]. As for the concept of Europeanisation, it is gradually becoming more and more significant in both academic and political circles involved in integration processes related to the EU. Scientists have repeatedly tried to find explanations for understanding the impact of the EU in both EU member states and non-EU countries. It is worth noting that the integration of the financial market with Europe implies the liberalisation of financial flows. This is an important source for stimulating the economy of a developing country, as it helps attract foreign investment both inside and outside the country. The development of the financial market at the level of one country requires passing through several stages: the creation of financial institutions, taking into account the need to move the country's financial resources; attracting foreign investment to expand financial globalisation; the development of created financial instruments; the liberalisation of financial operations [30]. Thus, Europeanisation can be defined as the internal influence of Europe in the sense that EU members and non-eurozone countries adapt and change internal institutions in response to EU rules and regulations.

In this context, the capital market of Ukraine cannot differ in any way from the capital markets in European countries and be part of these markets. To do this, Ukrainian companies should be able to invite financing freely for their development through various financial instruments. Currently, Ukrainian securities holders are not able to manage risks effectively. If the adopted Law No. 738 is successfully implemented in modern realities and the legislative field, Ukrainian investors will have more opportunities to invest and accumulate funds than government bonds, and the current rules of the game will provide basic protection against risks [15]. In this regard, our observations and special studies have shown that the state has prepared additional projects to create an effective securities market. In particular, former chairman of the National Securities and Stock Market Commission Timur Khromaev presented a draft memorandum on the establishment of the UIFC (Ukrainian International Financial Centre) at a meeting of the Cabinet of Ministers of Ukraine on January 20, 2020. This initiative was made possible by the adoption of the aforementioned law on simplifying the attraction of foreign investment and new financial instruments. The UIFC will be fully integrated into the Ukrainian legal system, as well

as provide equal opportunities and privileges to every local and international participant [31]. The project provides for the creation of a new land-based Regional Center for capital and commodity markets, which will consist of five institutions: an Advisory Council, an Investor Relations Bureau, an Arbitration Centre, a Universal Exchange and a Financial and Infrastructure Holding. Timur Khromaev stressed that the development of capital markets and commodity markets would lead to an acceleration of economic growth and an increase in the standard of living of Ukrainians [31]. This is the essence of the reform programme.

Today, experts on economic policy issues actively make assumptions about the effectiveness of the state initiative [31; 32]. They note that the main advantages of the project are: transparent rules and regulations; increasing the competitiveness of Ukrainian businesses in the international arena; increasing market activity – increasing the amount of taxable profit; improving competition – increasing foreign direct investment and GDP growth; improving the standard of living of Ukrainians; a stable pension system and raising pension rates; fair energy prices, etc. The launch of this project is scheduled for autumn 2023, but work is already underway to develop a legislative framework [31]. If Ukraine's access to the EU financial services market is expanded because of the creation of the UIFC, the initial effect is likely to be limited, since Ukrainian financial firms do not actively use the available opportunities to enter the EU market. Barriers to market entry for standard banking and insurance providers will also not change much: major players dominate the EU market, the cost of real estate and labour is high, and capital is expensive.

Expanding access to Ukraine's financial services markets may also have a limited impact on EU companies. European banks and insurance companies already have a significant presence in the Ukrainian market and were able to enter the market almost without problems. In the financial sector, Ukrainian financial companies have long been competing with foreign market participants. However, reducing barriers to entry for new players can increase competition in the market and reduce the share of the largest players. In the end, significant progress was observed in the implementation of EU standards in the field of financial services only with the participation of the NBU. Among financial services regulators, the NBU has more freedom of action in regulating banks, so it can implement most of the EU banking regulations without making changes to the relevant laws. Given that the parliament is slow to consider the necessary bills, the NBU can significantly speed up the European integration processes in Ukraine.

In the future, the EU and Ukraine need to find out the prospects for future integration between their financial services markets, choosing one of three possible options:

1. To implement the same mechanism in Ukraine that was proposed to the countries of the European Free Trade Association (EFTA). It should be noted that it provides for the introduction of EU legislation within the European

Economic Area [32-33]. Formally, the functions of the European supervisory bodies will be transferred to the EFTA super-visory body, and the regulators themselves will participate in the consideration and preparation of draft decisions for the EFTA supervisory body.

2. To propose a compromise that will expand the integration of financial services markets and reduce the regulatory burden associated with the full implementation of EU legislation. For example, Ukraine will be able to introduce all EU standards, except those that are the most difficult for market participants, in exchange for simplifying the procedures for Ukrainian companies to enter the EU market.

3. To abandon the idea of creating a single financial market. This will make the establishment of EU rules optional for Ukraine in this sector, and therefore more attention will have to be paid to the possible increase in the regulatory burden for market participants. At the same time, greater flexibility will be provided in the application of EU norms, which will become optional sources of regulatory practice.

Therefore, to maintain the proper level of development of the securities market, the legislation of Ukraine should be close to the EU legislation regulating financial services and should provide the necessary level of opportunities for the work of supervisory authorities and control mechanisms. Under such conditions, the process of Europeanisation will contribute to the spread of European values in Ukraine, and therefore increase the number of foreign participants in the securities market. In addition, the commitment of the Ukrainian population to Europe will help to adopt part of the EU's sectoral legislation.

Conclusions

The results of the analysis allow drawing some conclusions that are of interest for scientific research:

- The development of the Ukrainian securities market has recently been under pressure from global processes that determine the main challenges and trends of its further change. It cannot meet the needs of the Ukrainian economy, and therefore prevents Ukraine from taking a leading place in the international financial system. The main problem with the functioning of the market is its low competitiveness,

due to the lack of transparent operations in the market and undeveloped infrastructure;

- In the context of instability in the socio-economic sphere, financial flows to the real sector are reduced, and the problems of economic development of the country are aggravated. That is why European integration is one of the key national priorities that are emphasised and actively by political leaders promoted at the official level. Ukrainian economists, together with experts from Western European countries, hope for an effective redistribution of financial resources to the real sector of the economy. In addition, they form a set of measures to prevent duplication of functions of various financial market regulators and poor coordination between them.

The materials of this article can be useful for specialists who carry out state regulation in the field of financial services markets. In addition, this work deserves attention from managers, economists, financiers, those who plan to engage in entrepreneurship or already manage assets. However, the analysis of regulatory legal acts of Ukraine and the EU can arouse interest among political analysts, experts and consulting advisers. As for holders of securities, after reading them, they will be more aware of raising funds for the implementation of certain processes in the market. We plan to use the results of the study for future scientific research. Ways to improve the regulatory and methodological framework for regulating the securities market are among them. At the same time, we see the need to study the reasons for the low investment attractiveness of the national economy. We can assume that this is due to the lack of a coordinated strategy for the development of the securities market. Negative foreign economic factors reduce the ability of the model of economic development created in recent years (in particular, the securities market model) to guarantee the country's economic security, especially in the context of a sharp aggravation of disagreements in the global financial system. Accordingly, the analysis of unique factors that, combined with an efficient infrastructure, will contribute to the development of the Ukrainian economy is a priority in further scientific research.

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Тенденції розвитку ринку цінних паперів в Україні

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Анотація. Актуальність теми дослідження зумовлена стрімким розвитком ринку цінних паперів. Вже протягом тривалого часу в Україні відбувається вдосконалення фінансових інструментів, з'являються нові посередники та учасники ринку. Відтак зростає потреба в ефективному регулюванні змін, що мають переважно внутрішньоекономічну спрямованість і здатні впливати на різні сфери суспільного життя. Метою роботи є виявлення сучасних особливостей функціонування ринку цінних паперів на території України. З огляду на міждисциплінарність вказаної теми, провідними методами дослідження було обрано аналіз, синтез та індукцію. Ці системи процедур були об'єднані насамперед задля формування уявлень про зв'язок між економікою і правом. У цьому контексті перший метод сприяв об'єктивізації властивостей цінних паперів; завдяки синтезу вдалося зробити повні висновки та узагальнення щодо напрямів розвитку відповідного ринку. Заразом індукцію було використано для отримання загального висновку про можливості регулювання ринку цінних паперів. У статті було надано сутнісну характеристику понять «ринок цінних паперів» і «фондовий ринок». Крім того, було визначено структуру фінансового ринку: основних організаторів торгівлі та його учасників. Також було представлено основні закони у сфері правового регулювання ринку цінних паперів України та ЄС. Насамкінець було обґрунтовано розвиток українського фондового ринку в контексті євроінтеграційних процесів. Матеріали статті мають теоретичне та практичне значення для банківських працівників, спеціалістів фінансового управління, кредитних брокерів, аудиторів і страхових агентів. У зв'язку з наявністю опису міжнародної практики використання фінансових інструментів, дослідження може викликати інтерес у представників органів державної влади та освітніх організацій. Натомість наближення законодавства України у сфері обігу цінних паперів до європейських стандартів залишиться дискусійним питанням для кожної зі вказаних груп людей

Ключові слова: фондовий ринок, капітал, фінансові послуги, інвестиції, європеїзація

Criteria Description of the Measurement of the Circular Bioeconomy

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Abstract. With the implementation of the European Green Deal, the circular bioeconomy model is gaining in relevance as well as the concept of circular bioeconomy, which promotes a renewed economic approach to conducting economic activity. The transition of a socio-economic system from one qualitative state to another, causes the need to measure dynamic changes and establish progressive factors towards the formation of a circular business environment. The objective of the study is to monitor the measurement system of the circular bioeconomy and to outline criteria limitations and relevant indicators based on the defined characteristics. The methodological basis of the study consists of the methods of empirical and theoretical level, particularly the historical, abstract-logical, descriptive, comparative methods, method of observation and formalisation, theoretical generalisation, etc. In the process of scientific research, it was possible to carry out comprehensive monitoring of scientific developments of foreign and Ukrainian scientists and to establish existing methodological approaches to assessing the circular bioeconomy. A review of the literature provided an opportunity to identify key structural components that are within the sectoral space and targets that have a complementary relationship with the three-dimensional sustainable development. Sectoral segmentation and target gradation by circular orientation and bioeconomic manifestation allowed to form a system of indicators for measuring the circular bioeconomy according to the established criteria. The practical value of the study consists in the scientific substantiation of the criteria characteristics of the measurement of the circular bioeconomy and the establishment of a system of indicators with relevant limitations

Keywords: assessment system, circular measurement, bioeconomic manifestation, criteria limitations, sectoral space, targets, indicators, approach

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Introduction

In the context of the strengthening of European integration processes and the popularisation of the European Green Deal, alternative economic approaches to conducting economic activities are becoming relevant, which make it possible to minimise anthropogenic pressure on the environment and overcome the imbalance of the socio-economic system. Among these areas, special attention should be paid to the concept of circular bioeconomy, which promotes the implementation of a closed production cycle in order to reduce organic household waste and industrial residues. On the way to the development of a circular business environment, it becomes necessary to establish favourable progressive factors that cause dynamic changes. The ability to evaluate these changes will contribute to the adjustment of the national strategy and the formation of an effective state policy to support the closed production cycle. The implementation of this task requires the development of a comprehensive system for assessing the level of circular bioeconomy with the allocation of criterion constraints and relevant indicators, which determines the relevance of the chosen topic.

At the moment, the world scientific community is actively working on the development of a system for assessing the bioeconomic foundations of management and its active implementation in practical use. Scientists of European countries have managed to improve the procedure for assessing bioeconomy due to the effect of scaling indicators united by a flexible multi-level measurement system formed in accordance with the goals of EU bioeconomy [1]. T. Ronzon, S. Piotrowski, S. Tamosiunas et al. have tested the methodology for measuring the bioeconomy in European countries, comparing it with the results of other countries' assessments [2]. Lithuanian scientists focus on measuring the efficiency of bioeconomic activity in various sectors using the Cobb-Douglas production function [3]. A model of the geographical distribution of countries by indicators of bioeconomic activity was proposed T. Ronzon and R. M'Barek [4].

Unlike foreign experience in Ukraine, bioeconomic science research is at the initial stage, which encourages focusing on the issues of bioeconomy evaluation. Consequently, one of the leading Ukrainian scientists in the study of economic activity on a biological basis, V. Baidala in her own scientific works claims that monitoring of bioeconomy should be based on a classification of indicators that make it possible to assess the ecological and economic state of production [5]. At the same time, the author expresses the vision that in addition to the need to assess the level of development of bioeconomy, it is important to monitor the effectiveness of its growth [6, p. 34]. The corresponding assessment system makes it possible to identify the productivity of bioeconomic activity at the macro, meso and micro levels. For their part, Lithuanian scientists [3] propose to measure the effectiveness of the bioeconomic system using the modified Cobb-Douglas production function, which shows the relationship between changes in the resources involved in the production process and the volume of production on a biological basis, which also deserves special

attention. A. Ryabchenko focuses on the indicators of bio-product production, which are formed in accordance with parametric characteristics, namely: "1) sustainable biomass production; 2) increase in the added value of biomass while reducing energy costs; 3) optimisation of the cost of ecosystem services and economic efficiency of biomass-based production; 4) increase in the added value of biomass products" [7].

The actualisation of the topic in the educational space by the importance of promoting bio-based production with the predominance of the circular economy for the sake of a balanced development of society has contributed to a scientific study *whose main objective* is to form its own system of measuring the circular bioeconomy according to the established criterion limits. This can be realised through the study of foreign sources and Ukrainian scientific literature, its systematisation and generalisation of existing methodological approaches; identification of key structural components of measuring circular bioeconomy and substantiation of criterion restrictions, which will make it possible to form a system of indicators according to the established criterion characteristics.

Materials and Methods

Achieving results in the process of scientific knowledge makes it necessary to provide a methodological explication of sequential actions, which will become a guide in the study of the problems of evaluating circular bioeconomy. A methodological analysis is a basis for building the author's measuring trajectory for the development of circular bioeconomy with an emphasis on the formation of criterion constraints and their significance in the evaluation process. Therefore, it is proposed to consider a step-by-step algorithm of the conducted research on the system approach in Figure 1. The primary basis of scientific research is the study of foreign and Ukrainian experience for the objective characterisation of existing methodological approaches to measuring circular bioeconomy, which will make it possible to systematise the criteria features of the evaluation process within separate structured components and model the position on the formation of a system of indicators based on criteria characteristics. To implement the tasks of scientific research, a systematic approach was used, which is aimed at a comprehensive substantiation of many complementary ideas of leading scientists on measuring circular bioeconomy and forming a holistic vision of the issue. The research of the circular bioeconomy assessment system was carried out using methods of theoretical, empirical and general scientific (theoretical-empirical) levels in their complementary relationship. For example, the historical method considers the fundamental basis of the evaluation process, while the abstract-logical method allows establishing relationships between existing methods and makes it possible to try to structure their key components. The observation method helps to identify criterion features and target the purpose of indicators within the criteria characteristics, the

comparative method helps to identify similarities and differences in the practice of generating a comprehensive assessment system, the descriptive method makes it possible to substantiate the parameters of the production of methodological approaches, and so on. As a result, the theoretical generalisations of the best practices of foreign and Ukrainian scientists, a comprehensive analysis and systematisation of the results of scientific research, became the impetus for modelling the author's system for monitoring the

level of development of circular bioeconomy, the criterion limitations of which were constructed using the logical formalisation method. A sample of indicators is identified according to certain criteria by means of a hypothetical method, etc. Consistent implementation of the tasks set made it possible to achieve the intended goals and conduct thorough scientific research, as a result of which the vision of the issue of measuring the level of development of circular bioeconomy was formed.

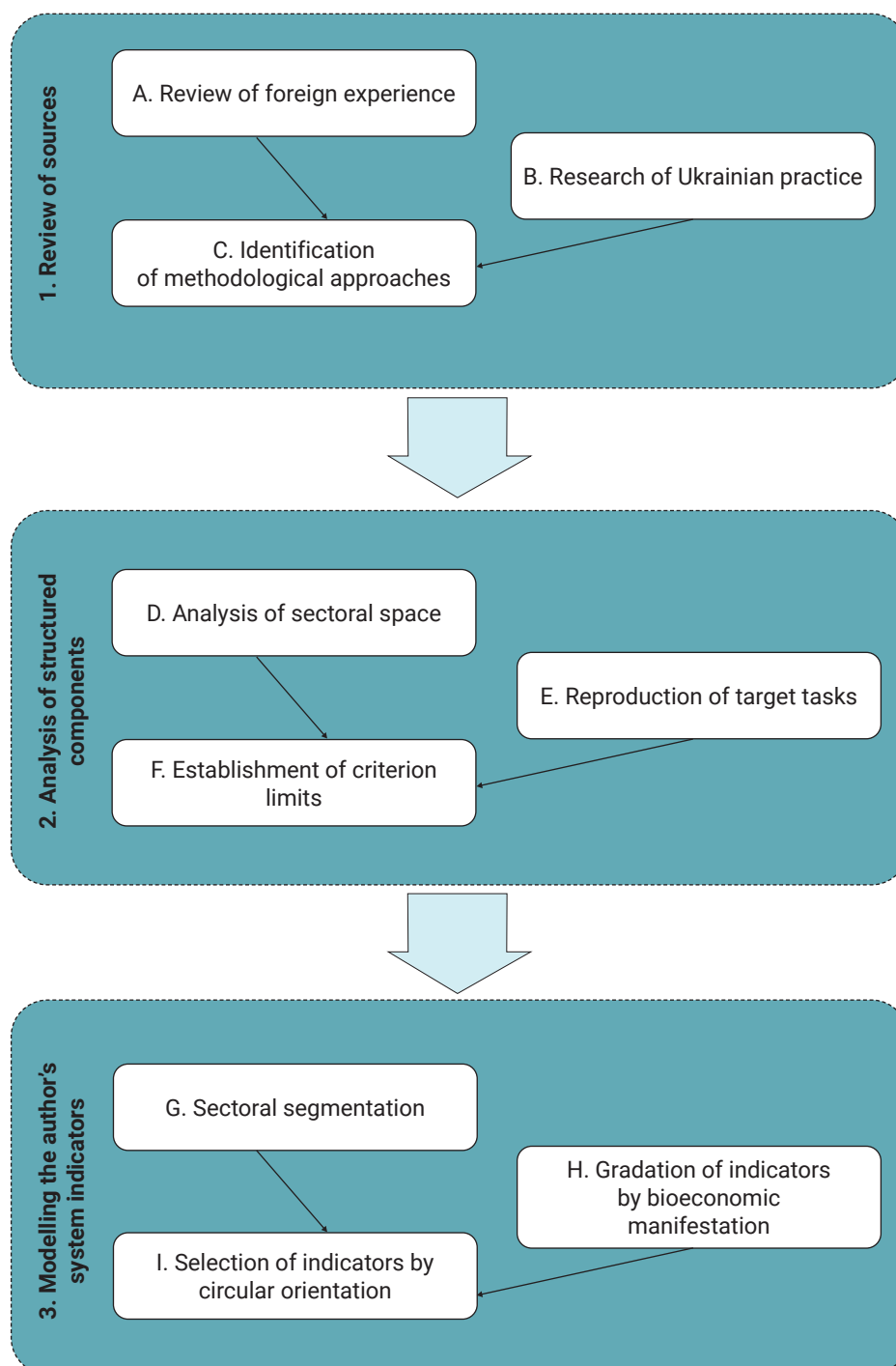


Figure 1. Step-by-step algorithm for forming a circular bioeconomy assessment system

Source: compiled by the author

Results and Discussion

The European system of monitoring the bioeconomic principles of management, launched in November 2020, covers a three-dimensional direction of achieving the goals of sustainable development, which allows assessing the economic, environmental and social progress of bioeconomic activities [1]. A feature of the European dimension is: 1) coverage of the primary sector, that is, agriculture, forestry and fisheries (percentage of deforestation in forests, used area of agricultural land and level of fish exploitation); 2) accounting for economic activities related to the production of goods and services based on renewable biological resources, creating a value chain from the supply of biomass by primary sectors to the transformation of products and their final consumption or reuse; 3) assessment of economic, social and environmental parameters [1]. Sources of data for monitoring the European bioeconomy are the national accounts of Eurostat [8; 9], statistics of industrial enterprises [10], production of goods and electricity [11; 12], which allow calculating value added by type of bioeconomic activity, the share of employed in the bioeconomic sector and the level of their labour productivity, features of biomass use and indicators related to the activities of the primary sector [13].

The guiding principles of the EU bioeconomy evaluation process are the regulatory criteria of the monitoring system, which at the initial stage were limited to the promotion of the Sustainable Development Goals, which later transformed into a vision, in addition to promoting the achievement of a sustainable goal, to take into account the need for climate neutrality, encouraging the transition to a circular economy and the development of sectors on a biological basis [14]. Currently, the criteria limitations of the European bioeconomy monitoring system cover targets at all stages of creating value chains within the implementation of environmental, economic and social directions.

A key position of the European bioeconomy assessment is the coordination of statistics by sector of bioeconomic activity, which is covered in the classification of economic activities of the European Community (NACE) [15]. According to this document, bioeconomy includes: agriculture (NACE code A01), forestry (A02), fishing (A03), manufacture of food products (C10), manufacture of beverages (C11), manufacture of tobacco products (C12) and manufacture of paper and paper products (C17). According to European standards, other sectors are considered hybrid, for which dual statistical information is recorded, in particular, products manufactured on a biological and non-biological basis (for example, textile production, in which both biomass (cotton, wool, silk) and synthetic fibres can be used as raw materials). For hybrid sectors, the identification of the share of bio-based goods is determined by experts by multiplying the volume of bio-based production (minimum range) by the proportion of bio-based products (minimum range). At the same time, it is proposed to calculate the average fractions of a biologically

based product from the minimum range. As for the share of the industry on a biological basis, calculations are made by dividing the production cost of products on a biological basis by the total cost of production of the corresponding sector. The share of the volume of electricity production on a biological basis (solid biofuels, charcoal, biogas, biodiesel, biofuels and renewable waste) is obtained by distributing all energy products on a biological basis to the total gross energy production, expressed in energy value [2].

The published work of the Food and Agriculture Organization of the United Nations (FAO) [14] on the definition of indicators for the assessment of sustainable bioeconomy, highlights a similar to the European, balanced approach in the economic, environmental and social dimensions. At the same time, there are noticeable differences in the limitation of a certain set of indicators, which are divided into two groups, namely: 1) indicators of the territorial level within the Sustainable Development Goals; 2) indicators of products (value chains), at the same time including those that cover the processes of standardisation, certification and labelling. Consequently, the criterion limitations of the proposed methodology, which reflects the participatory nature of its formation, are territorial localisation (global, national, regional level) and industry limitation according to the International Standard Industrial Classification of All Economic Activities (ISIC) [16].

The special feature of measuring the bioeconomy of individual countries, in particular Argentina, Australia, Germany, Malaysia, the Netherlands, and South Africa, comes down to economic criteria, which exclude environmental and social impacts. For example, the Malaysian bioeconomy index is represented by such economic parameters as value added from bioeconomic activities, exports of bioeconomic products, attracting investment in the bioeconomy, employment in the bioeconomic sector and productivity [17, p. 11]. The Finnish valuation system covers such indicators as biological output, value added, exports of goods, investment resources and employment. Germany is actively committed to improving the bioeconomy monitoring process and is developing an integrated approach, taking into account biomass flows, key economic performance indicators and bioeconomy modelling capabilities. Instead, the United States is limited to calculating industry-specific indicators of value added and employment in sectors related to the production of biological products [17].

Effective attempts by Ukrainian scientists to consider the features of national bioeconomic activity and develop a system for assessing its progress, made it possible to identify bioeconomic indicators according to the following principles: 1) the most effective need; 2) the objectivity of reflecting the processes of bioeconomy; 3) measurability and efficiency; 4) the unity of information from different sources; 5) the formation of initial information and its limitations; 6) the possibility of developing programmes for processing bioeconomic Information [5]. The basis for

forming a system of indicators for measuring bioeconomic activity is the gradation of biotechnology applications by colour sectors. Proponents of the sectoral approach highlight indicators of the annual volume of production of bio-products for certain branches of bio-economic activity, namely: agriculture, forestry and fisheries, food and forest industry, bioenergy; sub-sectors (chemical and textile industry, pharmaceutical industry, water supply, waste processing, construction, tourism, research and innovation); interrelated industries (supporting services (software) and technology sector, providing the activities of the main and sub-sectors); potential sectors of the national economy, the development of which it is aimed for the future [7].

A generalisation of foreign experience and a review of the evaluation practice of Ukrainian scientists gives grounds to assert that a unique international standardised system for monitoring circular bioeconomy is currently absent. The

available methods are mainly identified according to such criteria as: 1) the share of GDP accounted for by industries involved in the bioeconomic sector (sectoral approach); 2) are within the targets of sustainable development and the European course of "green" growth (target approach). At the same time, the criterion characteristics are often combined, since limiting the monitoring system to only a share of GDP is quite controversial, since excluding the environmental and social impact of circular bioeconomy is impossible due to the constant orientation.

The basic approach among scientists is defined as the sectoral approach, which causes the most controversy due to differences in the allocation of economic activities related to bioeconomy. Typing of relevant areas according to the classification of economic activities of the European Community (NACE) and national codification (KVED) is proposed to be considered in Table 1 [4; 18].

Table 1. Typification of industries in the circular bioeconomy monitoring system

KVED code/ NACE	Industries and activities	Fumagalli and Trenti	Efken et al.	Ronzon et al.	Piotrowski et al.	Own vision
A01	Agriculture	+	+	+	+	+
A02	Forestry	+	+	+	+	+
A03	Fishing	+	+	+	+	+
C10	Manufacture of food products	+	+	+	+	+
C11	Manufacture of beverages	+	+	+	+	+
C12	Manufacture of tobacco products	+	+	+	+	+
C13	Manufacture of textiles	+	+	+	+	+
C14	Manufacture of wearing apparel	+	+	+	+	+
C15	Manufacture of leather and related products	+	+	+	+	+
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	+	+	+	+	+
C17	Manufacture of paper and paper products	+	+	+	+	+
C20	Manufacture of chemicals and chemical products	+	+	+	+	+
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations		+	+	+	+
C22	Manufacture of rubber and plastic products			+	+	+
C31	Manufacture of furniture			+	+	+
D35	Electricity, gas, steam and air conditioning supply			+	+	+
E38	Waste collection, treatment and disposal activities; materials recovery					+
G46	Wholesale trade, except of motor vehicles and motorcycles		+			+
G47	Retail trade, except of motor vehicles and motorcycles		+			+
I55	Accommodation		+			+
I56	Food and beverage service activities		+			+
M	Professional, scientific, and technical activities					+
J	Information and telecommunications					+

Source: developed on the basis of [19-22]

The locomotive industry among the outlined ones, which is entirely related to bioeconomic activities, is the primary sector (A in KVED), since it plays a key role in ensuring a high level of food security in the country and produces raw materials in the form of biomass for the industrial and energy sectors. In addition to the agricultural sector, the secondary industrial sector (C and E in KVED) is significant for circular bioeconomy, since it is a raw material consumer that produces goods on both a biological and

non-biological basis (hybrid sectors) and provides a solution to the issue of industrial organic waste management. The tertiary sector covers economic activities related to the production of services, which include research work, the educational process, the information industry, the transportation system, and so on. At the same time, the service sector provides favourable scientific and technical conditions for the implementation of bioeconomic activities and plays an important auxiliary role in its reproduction (Fig. 2).

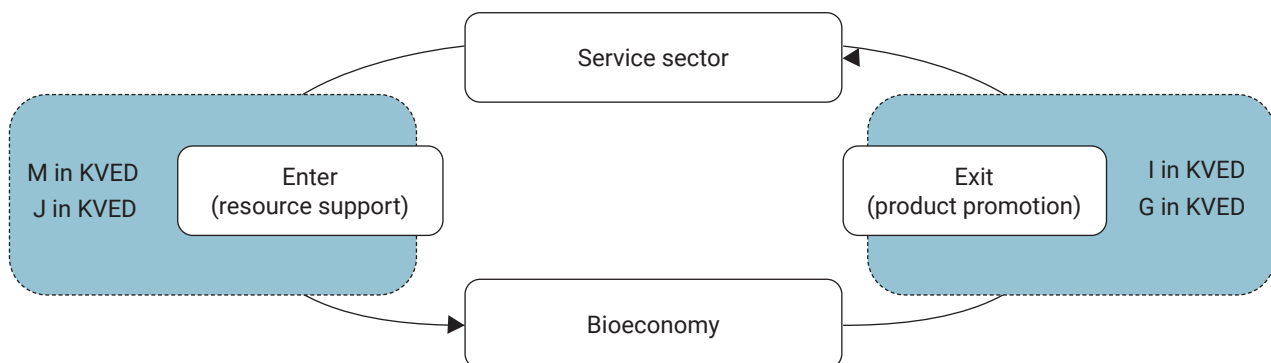


Figure 2. Complementarity of bioeconomic activities with the service sector

Source: compiled by the author

Within the existing sectoral space of circular bioeconomy, it is worth highlighting the bioenergy sector, given the powerful potential for transforming biomass

into a final product and a significant share of biofuels in the total amount of energy consumed (Fig. 3).

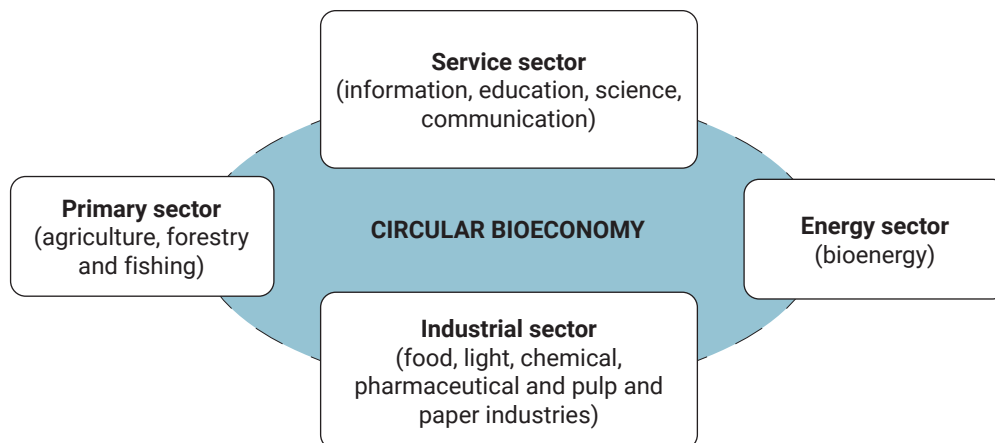


Figure 3. Sectoral space of circular bioeconomy

Source: compiled by the author

Activities within the aggregate sector space are aimed at implementing the basic goals of circular bioeconomy, in particular, 1) reducing the volume of organic production waste by organising business processes with maximum processing of the remaining consumed products, and 2) motivating business entities to step up production on renewable biological resources as a fundamental condition for the sustainable development of circular bioeconomy,

which makes it possible to overcome the imbalance of the ecological and economic system. Consequently, the basic criteria characteristics of the author's circular bioeconomy monitoring system define the target tasks, sectoral division and constant orientation of society's development. A graphical visualisation of the circular bioeconomy monitoring system based on criteria is shown in Figure 4.

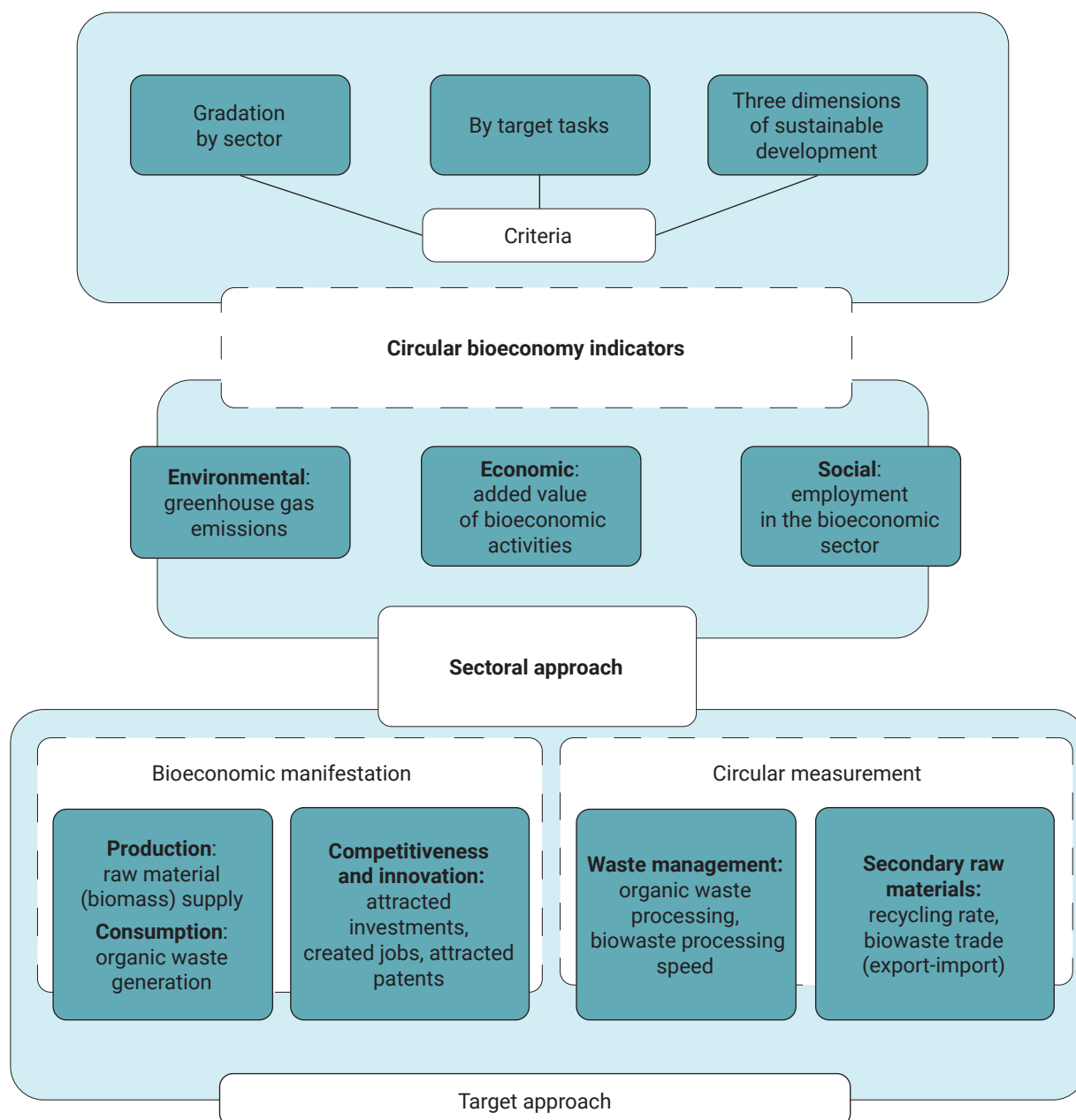


Figure 4. Criterion measurement of the author's circular bioeconomy monitoring system

Source: compiled by the author

The established criteria allow for outlining indicators for measuring circular bioeconomy within the framework of sectoral segmentation (sectoral approach), which provides for the determination of the economic (gross value added), environmental (greenhouse gas emissions), social (employment) component (three dimensions of sustainability) for the above-mentioned industries and types of bioeconomic activity. Criteria for target benchmarks are viewed through a target approach that combines the features of bioeconomic activity and takes into account the requirements of closed waste-free production (circular measurement). At the same time, the bioeconomic manifestation is determined by the indicators of production (availability of

biomass), consumption (volume of organic waste generated) and competitiveness (attracted investment in the bioeconomic sector, jobs created in the bioindustry, the number of registered patents related to bioeconomic activities). Within the framework of the circular measurement, secondary raw materials are evaluated by the coefficient of processing capability and the volume of exported or imported bio-waste, as well as indicators of processing organic waste are determined. The formed system of indicators for measuring circular bioeconomy is a scientific basis, which in the process of its practical implementation will make it possible to assess the state of bioeconomic activity at the moment and will make it possible to outline further strategic prospects.

Conclusions

Based on the study, it can be concluded that the vast majority of countries offer to measure the contribution of bioeconomy in terms of economic factors (for example, value added and employment). At the same time, environmental criteria for monitoring bioeconomic activity are often ignored. Given the importance of the ecological footprint in modern society and considering circular bioeconomy as a key trajectory of sustainable development, it is worth focusing on the use of a holistic approach that will emphasise the ecological significance of economic activity on a biological basis. Consequently, the author's circular bioeconomy monitoring system provides for the formation of methodological tools based on traditional sectoral segmentation (sectoral approach), taking as a basis three dimensions of sustainability, which, at the same time, is aimed at determining social well-being (employment), economic

growth (gross value added) and environmental equilibrium (greenhouse gas emissions). Taking into account the integrating concepts of circular bioeconomy, which are within the limits of ordinary goals and have a relevant character for their implementation, a target approach is proposed, the criterion characteristics of which are expressed through bioeconomic manifestation (production, consumption, competitiveness, activation of innovation) and circular measurement (processing of organic waste, the degree of use of secondary raw materials in the production process). The formed system of indicators based on criteria is a theoretical scientific asset, which in the process of testing will make it possible to carry out a comprehensive study of the development of circular bioeconomy and adjust national strategic guidelines for the implementation of an effective state policy to support the closed production cycle.

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Критеріальна характеристика вимірювання циркулярної біоекономіки

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Анотація. В умовах імплементації Європейського зеленого курсу, актуальності набуває модель замкненого циклу виробництва, разом і концепція циркулярної біоекономіки, яка пропагує оновлені альтернативні економічні підходи до ведення господарської діяльності. Перехід соціально-економічної системи з одного якісного стану в інший, викликає необхідність вимірювання динамічних змін і встановлення прогресуючих чинників на шляху до формування циркулярного бізнес-середовища. Тому метою наукового дослідження є моніторинг системи виміру циркулярної біоекономіки з виокремленням критеріальних обмежень та релевантних показників за встановленими характеристиками. Методологічною основою дослідження є методи емпіричного та теоретичного рівня, зокрема історичний, абстрактно-логічний, описовий, порівняльний, метод спостереження та формалізації, теоретичного узагальнення тощо. У процесі наукового дослідження було здійснено комплексний моніторинг наукових напрацювань зарубіжних і українських вчених та встановлено наявні методичні підходи до оцінювання циркулярної біоекономіки. Внаслідок огляду літературних джерел було виявлено ключові структурні компоненти, що знаходяться в межах секторального простору та цільових орієнтирів, які мають комплементарний зв'язок з тривиміром сталого розвитку. За допомогою секторальної сегментації та цільової градації за циркулярною спрямованістю та біоекономічним проявом було сформовано систему показників вимірювання циркулярної біоекономіки за встановленими критеріальними характеристиками. Практична цінність дослідження полягає у науковому обґрунтуванні критеріальних характеристик виміру циркулярної біоекономіки та встановленні системи показників за відповідними обмеженнями

Ключові слова: система оцінювання, циркулярний вимір, біоекономічний прояв, критеріальні обмеження, секторальний простір, цільові завдання, індикатори, підхід

Features of Marketing Promo-Campaigns of Ukrainian Confectionery Manufacturers within Domestic and Foreign Markets

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Abstract. The confectionery industry is of significant importance for the stable development of the country for many economic reasons, it's an ancient and effective industry, creating serious competition in the international market of confectionery products. Therefore the purpose of the scientific article is the analysis of the market of confectionery products in Ukraine and estimation of features of promo campaigns of the Ukrainian manufacturers of confectionery products. In the course of writing the article, both theoretical and statistical methods of data analysis were used. The found information about differences in marketing campaigns of Ukrainian manufacturers of confectionery products is supported by graphs, tables, and diagrams for clarity and ease of perception. It is pointed out that Ukrainian confectionery companies are competitive both on foreign and domestic markets. It has been found that the success of Ukrainian confectionery companies is based on many factors that influence their results to a different extent: management, product quality, logistics, start-up capital, the economic and political situation in the country, luck, and others. It is determined that the marketing campaign of the enterprise is used mainly to attract customers. The article also describes the promo campaigns of major national confectionery companies, their features, and differences, since even a few major players in this market have significant differences in marketing campaigns. The article, for practical purposes, can be used to study marketing methods often applied by large product manufacturers; to research the Ukrainian economy as a whole; to evaluate Ukrainian companies that are major suppliers to the Ukrainian confectionery market; by students to study marketing and advertising issues and various economic disciplines related to entrepreneurship

Keywords: marketing, promo-campaign, Ukrainian economy, confectionery companies, international competition

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Introduction

Marketing plays one of the most important roles in the development of a company in most industries, and a fundamental role in promoting the company's products to the market as well as building its image. However, marketing activities are difficult to isolate from the rest of the business because they work closely with the operations, the research, and the finance departments [1]. Marketing is a multifaceted entity that can be described from different angles. A universal definition can be considered that marketing is a system of views and actions related to justification, decision-making, and their realisation in order to meet the needs of market participants (both consumers and producers); mutually beneficial exchange of activities and their results, minimisation of risk in conditions of increased competition and dynamic general economic and market conditions [2]. Although marketing (marketing strategy, marketing campaign, or promo-campaign) for a company is one of the many components of achieving maximum profits (mainly in monopolistic competitive markets) by attracting more customers, capturing the market, more competent pricing policy, etc.

However, marketing activities should not be equated with sales or advertising, because they are just components of a single set of marketing efforts aimed at promoting a company in the market [1]. Thus, we can separately consider the advertising campaign, which is "a system of inter-related promotional activities covering a certain period of time and providing a set of application of advertising tools to achieve the advertiser's specific marketing goal" [3]. A sales strategy, in turn, is a plan of activities with the main purpose to increase sales volume and minimise costs by increasing the effectiveness of certain parameters [4]. A marketing campaign is a set of activities aiming to increase sales or services. They come in different types, depending on the objective, market model, scale, etc. In order to compile it, analysts carry out a marketing audit, the main purpose of which is to analyse the market, competitors, study demand, and others. Therefore, all three categories reviewed are rather abstract, flowing one into another, but are still parts of a marketing campaign.

Monopolistic competition is a market structure that combines elements of a monopolistic (differentiated products) and a perfect competition market (a large number of companies, relatively easy market entry, etc) [5]. Advertising plays a particularly important role in monopolistic competition. This is since in such markets it is important for companies to attract as many customers as possible to increase the demand for their products and, consequently, to reduce the demand for competitors' products, which maximises the monopolist's profit. Although the confectionery market has long been a monopolistic competition market type, it is now difficult to discuss this with certainty due to the fact that Roshen has taken a large share of the market. Thus, a well-thought-out marketing campaign (and especially creative advertising solutions) is still of particular importance in this market. The modern world where we have high competition in almost all markets for goods and services

dictates such conditions that it is important for each organisation to pay special attention to the development and improvement of its own marketing strategy, regardless of the size of the company [6]. Therefore, the relevance of the article is in the demand for analysis of marketing companies of major confectionery products manufacturers.

The purpose of the study is to evaluate the characteristics of the marketing campaigns of the main confectionery producers. This will help to determine how effective these companies are, and to draw conclusions about what causes these peculiarities.

Materials and Methods

Theoretical (analytical) and empirical methods were applied in the research. Theoretical methods were used in the analysis of scientific literature, various reports, documents, etc. Empirical methods were applied in the analysis of real statistical data and indicators related to the current state of international and national market of confectionery products, and in particular – analysis of prices in the Ukrainian market of confectionery products, and determination of market shares of major Ukrainian companies in the market. Graphs, tables, and schemes are used in the article for clearer analysis. To determine the positions of Ukrainian companies in the foreign market the international ranking Global Top 100 Candy Companies [7] was used. Thus, the main research methods are: historical (analysis of historical trends in the development of the market of confectionery products); abstract-logical (analysis of found information, synthesis, induction, analogy, formalisation, modelling, forecasting the behaviour of companies in modern conditions and the state of this market as a whole); abstraction; statistical (statistical observation, graphical method); monographic method.

In order to achieve this objective, the above methods were used in two stages of research. The first stage is a comprehensive analysis of the confectionery market in Ukraine, which includes both the market analysis itself and brief characteristics of some companies; it reflects the history of market development; it describes the competitive environment of the market; it describes the main marketing trends that are present in the market of confectionery in Ukraine and what steps and actions are optional for enterprises of this sector for further effective development. At this stage, an important conclusion about the market structure is made, trends in exports and imports of products of this sector in Ukraine are described as well as the competitive abilities of confectionery companies in foreign markets and their impact on foreign markets. This section is basic for understanding the confectionery market and the activities of companies within it.

The second stage of the research included a review of the marketing campaigns of some of the largest companies in this market, in particular, the confectionery corporation "Roshen", the confectionery product company AVK and the Kharkiv biscuit factory "Biscuit-Chocolate". At this

stage, differences in marketing approaches of these companies were demonstrated, advertising campaigns of the companies were considered, and the pricing policy of the companies was analysed based on the price data for similar types of products of the companies.

Results and Discussion

Before analysing the marketing campaigns of Ukrainian confectionery manufacturers, it is necessary to analyse the Ukrainian market for these products and the position of national companies in it. To begin with, it should be noted that Ukraine's share in the global market of confectionery products is estimated at USD 93 billion or 0.9% or 1 million tons of products. Thus, we can assume that Ukraine's production potential is not used to its full capacity. In addition, the Ukrainian market generally differs from foreign markets for confectionery products, and the main difference is that the Ukrainian market does not have the same variety of confectionery products as foreign markets [8]. In addition,

Ukrainians consume less confectionery in total (according to the State Statistics Service of Ukraine in 2018, Ukrainians spent an average of 250.14 UAH on confectionery products or approximately 2 kg of chocolate per year) due to the fact that the income level of Ukrainians does not allow them to buy as much, especially considering that they are not essential goods [9]. Due to the devaluation of the hryvnia and the decline in the purchasing power of the population, Ukrainian producers are increasingly focused on exporting products, mainly to markets in highly developed countries. In 2020, with the onset of the COVID-19 crisis, which led to a significant reduction in demand for products by about 10% and the closure of many outlets, Ukrainian companies faced new challenges to overcome. Global brands in the Ukrainian market include Nestle (owned by Lviv-based confectionery company "Svitoch"), Kraft Foods (owned by "Kraft Foods Ukraine"), Western Nis Enterprise Fund (owned by JSC "AVK"), and others. Figure 1 shows the changes in the volume of products volume produced by the confectionery companies.

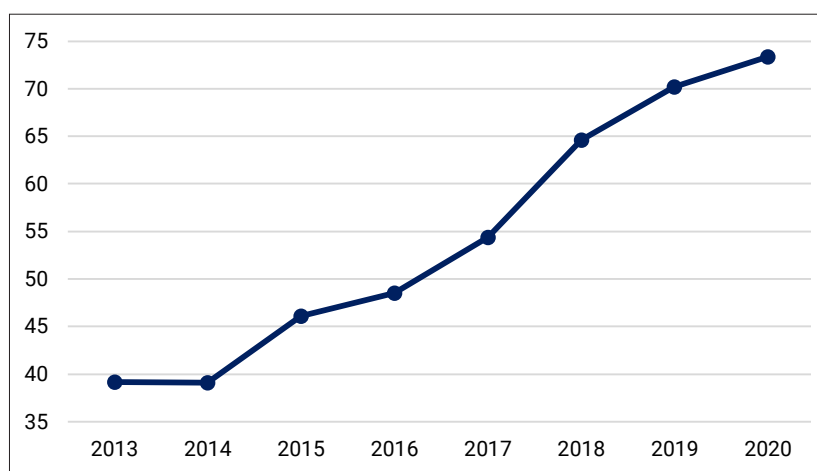


Figure 1. Changes in the volume of confectionery products produced by Ukrainian manufacturers in recent years, UAH billion

Source: compiled by the author based on data from [9]

Although the data are approximate and adapted, they nevertheless show that there is an increasing trend in the volume of production of this type of product in Ukraine. Table 1 demonstrates the shares occupied by the main types of products of the confectionery industry (the same main types of products of confectionery producers

are given by Zagrichanska and Golyuk [10] in their analysis of the confectionery products market in Ukraine). The difference in production shares arises not only because of different demand for products, but also because of different benefits received by companies for the sale of certain types of products.

Table 1. Shares of the main confectionery industries from 2013 to 2020, %

Year	Bread and bakery products, bakery confection, cakes, and short-term cakes	Biscuits and rusks; long-life bakery confection, cakes, and pastries	Cocoa, chocolate, and sugar confectionery
2013	29.1	19.0	51.8
2014	30.6	19.0	50.4
2015	32.2	26.0	41.8
2016	36.1	17.2	46.7
2017	35.3	14.0	50.7
2018	33.6	15.4	51.1
2019	33.9	15.9	50.2
2020	33.9	15.4	50.7

Source: created by the author based on [9]

Thus, the main type of confectionery production in Ukraine is cocoa, chocolate and sugar products, i.e. products of high price segment, although the demand for this type of products among Ukrainian population is decreasing [11]. The Ukrainian market for confectionery products collapsed after the events of 2013-2014, which was due to a variety of reasons, including general economic problems, closure of markets for products, and a decline in demand for their own products in the national market. This also affected exports, which decreased significantly during these years, as well as product quality, price, and quantity in the market. This was the main reason for AVK losing its leading position in the market and passing it to Roshen, as shown below, based on the companies' market shares in confectionery products. The 2013-2014 events have significantly worsened the position of national producers in both the Ukrainian market and international markets. One of the most important problems for Ukrainian confectionery producers is the lack of

a wide range of choices for customers, as companies only started experimenting with products a few years ago after realising that the market needed it. Therefore, one of their most important tasks is to diversify their products, produce new types (especially chocolate products as they are the most popular among other types of products) and apply non-standard marketing methods. This will also help companies to enter the EU markets, which is of particular importance as Ukraine has lost a significant market share in Russia after the events of 2013-2014. Before that, the market suffered significant shocks in 2008: at that time, companies in the confectionery market had a significant drop in revenues due to the loss of purchasing power among the population, but a strong recovery in most product subspecies has already begun since 2009 [12]. To assess the impact of Ukrainian confectionery companies, the index from Candy Industry will be applied, which produces information on the top 100 confectionery companies each year.

Table 2. Excerpts from Global Top 100 Candy Companies as of 15 February 2021

Company	Ranking position	Location	Net sales, mln USD	CEO	Number of employees	Number of factories
Mars Wrigley Confectionery, div. of Mars Inc.	1	Chicago, Illinois, USA	20000	Andrew Clarke	34000	53
Ferrero Group	2	Alba, Italy	13566	Lapo Civiletti, Giovanni Ferrero	36372	31
Mondelez International	3	Deerfield, Illinois, USA	11467	Dirk Van de Put	80000*	150*
Meiji Co. Ltd.	4	Tokyo, Japan	10075	Masahiko Matsuo, Kazuo Kawamaru	10815*	7
Hershey Co.	5	Hershey, Pennsylvania USA	8066	Michelle Buck	16140	14
...						
1-800-FLOWERS.COM Inc.	28	Carly Place, New York, USA	625	Chris McCann	3300**	4
Roshen Confectionery Corp.	29	Kyiv, Ukraine	800	Vyacheslav Moskalevsky	10000	8
Henry Lambertz GmbH & Co. KG	30	Aachen, Germany	793	Herman Bulbecker	4000	9
...						
Zertuz GmbH	72	Hamburg, Germany	217	Alexandra Kama	1130	6
Millennium Chocolate Factory	73	Dnipro, Ukraine	205	Evgeny Sharinov	3000	2
ICAM SpA	74	Lecco and Orsenigo, Italy	202	Angelo Agostoni	420	2
...						
Hlebprom	88	Moscow, Russia	149	Yaroslav Shadyria	3770	4
Konti Group	89	Donetsk, Ukraine	147	Sergey Mishalov	8097	5
Nellson LLC	90	Anaheim, California, USA	145	Jamie Batter	1400	3

Notes: * – including all products (not just confectionery); ** – company has 3,000 employees working all year round; 8,000 seasonal

Source: compiled by the author on the basis of [7]

Table 2 shows that Ukrainian manufacturers have relatively high positions in this ranking and can compete with foreign corporations. There are three Ukrainian companies included in the ranking, but their positions have dropped significantly: in 2016 Roshen was at 24th position, Konti was at 43rd, and AVK was ranked at 67th position (Millennium Chocolate Factory was not included in this ranking, indicating a significant strengthening of its position in the markets in recent years).

The confectionery industry in Ukraine is one of the few successful and attractive sectors of the domestic economy. The average level of production profitability is estimated at 15-20%; about 60% of enterprises operate at a profit, 30% make no profit and 10% are loss-making [13]. The main characteristics of Ukrainian products are low price, good reputation, high-quality products, and highly qualified labour. The price is so low, even by Ukrainian standards, that reducing it even further is simply not possible, due to the loss of quality and the loss of consumer confidence. Those manufacturers who have tried to significantly reduce the price have only hurt their business. The inability to reduce the price without a huge decrease in product quality lies in the peculiarities of this type of business: products cannot remain in storage for a long time; the main suppliers of cocoa beans are African countries characterised by a low level

of technology, which makes the price for this resource higher than it could be; significant dependence on natural conditions: any drought or long rainy season can make the price rise; the significant costs for transport and energy in production [14].

It is also worth mentioning that a small part of this market in Ukraine is being imported: in 2017, due to the official data (excluding shade), the share of imports in the market structure was 4.4%, and in 2018 it was 5.5% [9]. Nevertheless, this share is gradually increasing year by year, and with it the share of national products on the market is decreasing. In general, exports of Ukrainian products abroad are steadily increasing due to problems on the domestic market and the ability of companies to compete on the international market. The country mainly exports expensive confectionery products (cocoa, chocolate, sugar confectionery), with an export part of 30%; flour confectionery products (cakes, pastries, rusks, biscuits), with an export part of 20%; sugar, with an export part of 10% [15]. Most likely, Ukrainian companies will continue to be exporting their products abroad, especially to the European Union, although during the COVID-19 crisis, due to the introduction of tariff restrictions, there were fewer opportunities for companies to develop exports. Thus, Table 3 and Table 4 demonstrate trends in the market division between the main producers of this type of product.

Table 3. Share of confectionery companies by product type, %

Type of product					
Bakery products		Pastry		Chocolate products	
Company	Share	Company	Share	Company	Share
PRJSC "Mondelez Ukraine"	13.8	SC "Roshen Confectionery Corporation"	46.1	SC "Roshen Confectionery Corporation"	27.5
PRJSC "Kharkiv Biscuit Factory" (HBF)	9.8	"Distribution Centre Plus" LLC	24.2	"AVK CONFECTIONERY" LLC	16.3
SC "Roshen Confectionery Corporation"	6.8	PJSC "Mondelez Ukraine"	6.2	PJSC "Mondelez Ukraine"	14.7
"Grona LLC"	5.7	"Tri Star" LLC	3.9	"Distribution Centre Plus" LLC	7.5
"Distribution Centre Plus" LLC	4.2	"Druzhkovskaya" LLC CF	3.6	PRJSC "Kharkiv Biscuit Factory"	5.9
"LUKAS" MTC PE"	3.9	PRJSC "Kharkiv Biscuit Factory"	2		
		PE "Licom"	1.3		

Source: compiled by the author on the basis of [13]

Table 4. Production volumes and market share by main companies in the confectionery market in 2018-2021

Confectionery enterprise	Production volume, tonnes			Market share, %		
	2018	2019	2020	2018	2019	2020
1. "Roshen" Corporation	205112	194168	200834	23.29	29.59	28.73
2. PRJSC "KHBF"	50619	52873	55357	6.07	7.63	7.92
3. PRJSC "AVK"	97958	41780	53132	11.75	6.03	7.6

Table 4, Continued

Confectionery enterprise	Production volume, tonnes			Market share, %		
	2018	2019	2020	2018	2019	2020
4. JSC "PA"Konti"	32348	30996	29953	3.88	4.47	4.29
5. "MIR" Confectionery" LLC	16245	16210	21666	1.95	2.34	3.1
6. PJSC "Mondelez Ukraine"	25150	19793	21576	3.02	2.86	3.09
7. PJSC "Lviv Confectionery "Svitoch" 22561	22561	20480	20175	2.71	2.95	2.88
8. PRJSC "Dominik"	19805	19711	18468	2.38	2.84	2.64
9. PRJSC "Zhytomyrski lasoshchi"	38767	32651	14780	4.65	4.71	2.11
10. PRJSC "Lagoda"	12762	12852	11942	1.53	1.85	1.71
11. "Kviten" Confectionery" LLC	7289	5393	6532	0.87	0.78	0.93
12. PJSC "Zaporizhzhya Confectionery"	3012	3214	3935	0.36	0.46	0.56
Others	302161	243084	240620	37.54	33.489	34.44
Total:	833789	693205	698970	100	100	100

Source: compiled by the author on the basis of [16]

The tables above show that the confectionery market is very highly concentrated, although not monopolistic. According to Ukrainian legislation, a market can be considered monopolised if the share of one company exceeds 35%, three companies – 50%, and five companies – 70%. In this case, such a trend is not observed: the share of Roshen is 28.73%; the share of Roshen, "KHBf" and "AVK" is 44.25%; the share of Roshen, "KHBf", "AVK", "Konti" and "MIR" Confectionery" is 51.64%. We can observe a clear tendency for Roshen market share to increase, as well as a strong decrease in the share of "AVK". Such an increase in market share of the largest companies in the industry has been observed continuously since at least 2003 [17]. Nevertheless, there is still competition in the confectionery market as there are approximately 5459 operating companies: 6 large, 274 medium, and 5179 small businesses [8]. It is this large number of small businesses that prevents the confectionery market from becoming an oligopoly; there is always the possibility of new competitors entering the market. The peculiarity is that these small companies are regional, i.e. they occupy an extremely small part of the market. Their small size causes their products to be more expensive, and their production remains high-cost and inefficient, but despite this, they find their customers. Among chocolates, milk chocolate is still the most popular, followed by dark chocolate, and white chocolate is still not very popular among consumers.

It is important for manufacturers to keep their products recognisable and different from others, as if they are significantly similar in quality and appearance, the number of customers may decrease. As mentioned above, companies have recently started experimenting with product flavours and diversifying products to attract new customers, but most of them are not full-fledged new flavours, but differences in filling (consistency or flavour concentration). The biggest change came in chocolate bars: as national manufacturers do not have extraordinary flavours available, they started filling standard chocolate bars with jams, caramel, nuts, wafers, biscuits, peppers, and others [8].

To remain competitive, confectionery companies need to react quickly and adapt to the desires of the market. Nowadays, confectionery companies have been forced to intensify their own marketing policy. The amount of money spent on advertising has increased considerably: about three-fold. So, the annual budget for the implementation of the marketing strategy of a small company may be more than \$ 1 million, and in large enterprises – more than 20 million dollars. The reason for this is the same high level of competition for markets between companies to increase demand for their products, to make them more recognisable.

A possible option for further development of the industry is to enter the Asian market, as these countries have a huge market and growing economies. There, with improving living standards, citizens will begin to spend more on confectionery products in the future, as evidenced by the high rates of demand for chocolate in recent decades in China and India [10]. Nevertheless, entering these markets will be a challenge for Ukrainian companies: to do so, companies must create fundamentally new types of products, as Asians love unusual, bright packaging design (as well as creative, unusual, and sometimes strange for Europeans advertising) and seemingly incompatible tastes (for example, products with a spicy-sweet taste).

Recently, Ukrainian producers have mastered the production of some new products, namely cocoa oils, cocoa fats, and products for making cocoa-based drinks. In addition, the production of sugar confectionery products with such components as fruits, berries, nuts, fruit, and other plant peels and other types of products has increased significantly. A possible new product on the national market from the national producers will be an organic chocolate, which is currently only available as an imported product in Ukraine. Its production is promising and has significant potential. Another possible option for these companies, as an element of diversification, is the sale of by-products such as tea, coffee, chicory, spices, essences, and others. In addition, companies can start to specialise in specific types of products, for example – products for diabetics, made with

sugar substitutes, or vegan confectionery products based on whipped coconut cream and milk. This will give Ukrainian enterprises a particular advantage on this market in the future, as this niche is still relatively vacant.

The article will further focus on the specifics of each

company's marketing activities. For an initial assessment of the specifics of each company's marketing activities, it is worth giving brief statistics on their pricing policies. Thus, in Table 5, the prices of some of the products of these companies are provided.

Table 5. Price comparison among confectionery market leaders in Ukraine in 2021

Product	Price, UAH			Average price	Deviation from the average, %		
	Roshen	AVK	KHBF		Roshen	AVK	KHBF
Chocolate, price per 1 g	0.343, 80%	0.351, 80%	0.316, 75%	0.34	1.78	4.15	-6.23
Chocolate, price per bar	29.19	31.60	31.56	30.78	-5.18	2.65	2.52
Waffles, price per 1 g	0.12	0.48	0.15	0.25	-52.00	92.00	-40.00
Wafer sweets, price per kilo	139.90	190.00	115.50	148.47	-5.77	27.97	-22.20
Candy with nuts, price per kilo	189.00	145.00	139.12	157.71	19.84	-8.06	-11.79
Candy "Ptashyne moloko", price per 1 g	0.23	0.29	0.26	0.26	-12.13	10.71	1.42
Fruit candy, price per kilo	77.46	69.00	79.00	75.15	3.07	-8.19	5.12

Source: compiled by the author on the basis of [18]

In Table 5 we can clearly see the tendency that the price in AVK is generally higher (and sometimes much higher) than in other companies in the sector. At the same time, depending on the type of product, the price may be the lowest at both Roshen and KHBF. However, it is worth noting that products in this market are not fully homogeneous and suitable for comparison as all confectionery products have their own peculiarity: even two seemingly identical chocolate bars from different companies may have different taste and composition, which may play a decisive role for the buyer. In addition, it has been discovered that a large number of "AVK's" products have recently been withdrawn as the company declared bankrupt in the summer of 2021. The reasons given for the company's bankruptcy are poor management and the loss of factories and plants in Donetsk and Luhansk regions.

Let's start with Roshen, which, as already mentioned, has the largest market share and specialises in chocolate products (or sugar confectionery), although it produces all kinds of products. The company's products are often wrapped in kraft paper, which gives the product an external appeal and the minimalist design of the packaging adds to its aesthetics [19]. The same trend can be observed in commercials, where dark colours prevail, creating a certain brand and product associations in the viewer. The main cost of advertising is used to promote new products, because old products are already well known, some from Soviet times. In addition, the price of the company's products is relatively lower than that of other manufacturers. Speaking of product features, Roshen has launched products that combine several flavors at once. Since these products are relatively more technologically advanced and also have a comparatively higher

demand, such changes can be considered successful for the company in the long run. The same can be said about Roshen bars, which are still popular with customers due to their positioning as a "quick snack"; in addition, they are still a relatively cheap product compared to other types of products. To summarise, Roshen has a sound marketing policy that has enabled it to achieve a large market share and increase profits; this has mainly been achieved through better pricing, a better understanding of the market, and the creation of a recognisable Roshen brand among consumers.

Let's also look at the products of "AVK", which specialises in a variety of confectionery products, and even vegetable meat. Its main products are cacao, chocolate, and sugar confectionery; nuts and raisins are the most common additives in its products. As stated above, its products have a relatively higher price than those of its competitors due to overpricing by retailers. In order to somehow influence the price, the company gives discounts to retailers for bulk purchases. It also has a differentiated pricing policy, i.e. it charges different prices for its products depending on the region. The company's packaging designs are also special, characterised by a festive and bright appearance [19]. For advertising, the company also uses dark colours, but they are more in harmony with bright, yellowish colours. Recently, the most frequent advertising of this company has been on "STB" channel, where the message is created on the cozy, peaceful home atmosphere, although in the early commercials a completely different atmosphere prevailed, in particular loftiness, royal nobility, and splendour (advertising of sweets "Royal Charm"). This marketing policy was sound because the company needed to build its brand recognition, especially for "AVK", as it had lost a significant part of

its market; however, it was not enough to fix all the problems the company had. The company was a pioneer in some products: it was the first to launch sugar-free chocolate, filled biscuits, chocolate chips, and other types of products. However, the company lost market leadership after 2014 due to the loss of access to its main production facilities in Donetsk and Luhansk regions. It is still healing from those losses, paying off debts and occasionally showing losses in its reports [20]. As indicated above, the company has been declared bankrupt, indicating the inefficiency of the company and its failed attempts to climb out of the debt hole. It is likely that the company will no longer be at the top of the market in 2021; its marketing campaign has failed, although it is worth admitting that the main reason for this was its incredibly difficult financial situation.

The last company under review is KHBF. The company specialises in the manufacture of flour and sugar confectionery, although its product range is quite extensive. The packaging design is bright and “juicy”, accommodating light and dull colours. Interestingly, the company does not have as interesting and thoughtful advertising as the two above-mentioned companies, yet it consistently remains in the lead. The company’s products are well known among the local population and tastes are recognisable; in addition, many of its products are priced below the market average. Most of its products are exported and the company intends to increase this share over time, targeting foreign markets. The situation at “Biscuit-Chocolate” is therefore quite interesting: the company does not spend a lot of money on advertising its products, and yet it still sells well. By saving money, the company keeps the prices of its products below the market, which allows it to have a larger share of the market.

Conclusions

The paper examined the market for confectionery manufacturers in Ukraine, its main features, and its differences. It was noted that recently the market has been monopolised: in 2020 Roshen had the largest market share (28%), while the closest competitors had slightly less than 8%. However, it is also confirmed that until the share of Roshen is equal to 35% it cannot be called a monopolist in the industry. Ukrainian confectionery companies have been found to be serious competitors to international companies due to their low price and relatively high quality.

Thus, the study substantiated that since the market is monopolistically competitive, company marketing is of particular importance, as the main goal of companies is to capture as much of the market as possible to maximise profits. In the case of the Ukrainian market, relatively low prices remain important due to the low purchasing power of the population. Therefore, most companies in the market pursue marketing strategies whereby the amount of money spent on product promotion does not significantly increase the price of the product, although, the costs of product promo are still impressive in most companies in the industry. The marketing strategies of the three main companies in the confectionery market were examined in detail. Thus, AVK, which was the market leader in 2020, is likely to lose its leadership in 2021 due to inefficient business practices and too much debt. “KHBF” has chosen a strategy of price minimisation, which makes its products indeed the cheapest, and achieved through low advertising costs for the company. Roshen, on the other hand, is the “golden mean” between the two companies, as its advertising budgets remain impressive, but at the same time, the price of its products on the market remains low.

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Особливості маркетингових промо-кампаній українських виробників кондитерських виробів на внутрішньому та зовнішньому ринках

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Анотація. На міжнародному ринку кондитерських виробів існує серйозна конкуренція, оскільки означена галузь є досить давньою та ефективною, а також важливою для стабільного розвитку країни з багатьох економічних причин. У зв'язку з цим метою наукової статті є аналіз ринку кондитерських виробів в Україні та оцінка особливостей промо-кампаній українських виробників кондитерських виробів. Під час написання статті використовувалися як теоретичні, так і статистичні методи аналізу даних: у роботі знайдена інформація про відмінності маркетингових кампаній українських виробників кондитерських виробів для наочності та простоти сприйняття інформації, підкріплена графіками, таблицями та схемами. Вказано, що українські кондитерські компанії є конкурентоспроможними як на зовнішньому, так і внутрішньому ринках. З'ясовано, що успішність функціонування українських кондитерських компаній ґрунтується на багатьох чинниках, які різною мірою впливають на їхні результати: менеджмент, якість продукції, логістика, стартовий капітал, економічна та політична ситуація в країні, удача тощо. Визначено, що одним із найбільш значущих чинників є маркетингова кампанія підприємства, основною метою якої є залучення клієнтів. Також у статті описано промо-кампанії основних національних кондитерських компаній, їхні особливості та відмінності, оскільки навіть у кількох основних гравців на означеному ринку маркетингові кампанії мають значні відмінності. Стаття в практичних цілях може бути використана для вивчення методів маркетингу, якими часто користуються великі виробники продукції; для дослідження економіки України загалом; з метою оцінки українських компаній, які є основними постачальниками на український ринок кондитерських виробів; студентами для вивчення питань маркетингу та реклами, а також різних економічних дисциплін, пов'язаних з підприємництвом

Ключові слова: маркетинг, промо-кампанія, економіка України, кондитерські компанії, міжнародна конкуренція

Model of Substantiation of Organizational Structure of the Management System of Higher Education

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Abstract. The relevance of the research is determined by the need to update the management structure of scientific projects within higher educational institutions in accordance with modern economic realities and internationally recognized standards, the essence of which is the transition from a rigid hierarchical management system and orientation towards the commercialization of the results of scientific and technological activities. Therefore, the purpose of this scientific article is to develop a functional model for scientific project management within higher education, the components of which, unlike existing models, will be characterized by a project-oriented direction. To achieve a certain research goal, general scientific research methods were used, including analysis, synthesis, generalization, comparison, systematization, modeling, as well as structural and mathematical methods, taking into account the key principles of structural-functional and system approaches. The article analyzes a number of scientific works of Ukrainian and foreign scientists on the topic of methodological substantiation of the specifics of management of research projects in higher educational institutions. The key concerns of the current state of scientific project management within the Ukrainian scientific space have been identified, in particular, the rigid organizational and staff management structure with the predominant role of the top management, insufficient financial support of scientific and technical activities, as well as limited access to the results of scientific and technical activities. The author's economic and mathematical model of scientific project management in higher education institutions has been developed considering functional indicators. It is proposed to introduce a body for commercialization of the results of scientific and technical activities, which will help optimize the financial support of scientific and technical activities. The necessity of developing international cooperation within the framework of scientific and technical activities and the organization of scientific projects in particular is substantiated. The practical value of scientific work lies in the development of the author's own methodological support for the proper functioning of scientific project management with the prospect of its further application in practice

Keywords: economic model, scientific project, higher educational institutions, scientific and technical activities

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Introduction

The modern system of higher education institutions is characterized by a complex and extensive management structure, in particular in the process of conducting scientific research, as a result of which each individual scientific project has a certain number and stamp. Such an organization creates a number of restrictions on access to the results of scientific activities both for the general public of scientists and for representatives of the business environment. This, for its part, leads to a situation in which different scientific institutions, departments and structural units of scientific organizations solve identical problems or symmetrical problems. Thus, the question is about the irrational repeated spending of public financial resources to achieve similar goals, which in the end are not always implemented in time or not implemented at all. Therefore, there is a need to find a proper optimized model of organizational structure in the management system of higher educational institutions, which confirms the relevance of the study.

The issue of scientific project management has repeatedly become the subject of theoretical scientific research by both Ukrainian scientists and representatives of other countries. In particular, the Portuguese authors D. Oliviera, J. Neves, D. Raposo and J. Silva looked for ways to simplify the management of a research project in the context of communication design, focusing on ergonomics and the human factor [1]. Malaysian researchers C.M.M. Chin, A.C. Spowage, E.H. Yap and C.W. Lee studied the planning and management processes of research projects among doctoral students [2]. Scientists have found that doctoral students are not sufficiently aware of the proper use of project management methodologies, as a result of which there is a need to update the organizational framework. Scientists from Australia, Norway and Canada, namely S. Sankaran, R. Muller and N. Drouin, focused on the analysis of collaboration in project management research [3]. In particular, the authors draw attention to international cooperation between developed countries and developing countries, in the context of which the issue of research management is raised. Scientists also conducted an empirical study that provided for determining the prerequisites for international scientific and project cooperation, among which the reputation of leading researchers, the prestige of institutions, etc. were identified [3]. Especially important for scientific intelligence are the achievements of K. Piwowar-Sulej [4]. The scientist conducted an empirical study, during which managers of the financial industry were interviewed, which contributed to further identification of recommendations on management practices in the context of a successful scientific project. Among the Ukrainian researchers of the chosen topic, it is advisable to mention L. Domnin [5], R. Bulhakov, V. Holovan [6], D. Novikov, A. Sukhanov [7], F. Pedan, G. Rudenska, M. Tkachenko, R. Fedorenko [8]. One way or another, these scientists in their works revealed the methodology of modern scientific project management.

It is worth noting that each higher education institution has a certain number of scientific projects, the

implementation of which is included in the annual plan. It is obvious that all projects are characterized by an admissible range of time period to start their implementation, the required amount of attracting public financial resources at the stages of implementation, the expected amount of profit from their implementation, and so on. Therefore, there is a need to find ways to implement scientific projects in order to obtain maximum financial benefits in accordance with the dynamics of financial opportunities. This determines the conduct of scientific research, *the purpose of which* is a development of a model for managing scientific projects in higher education institutions, the structural elements of which, unlike existing models, will be optimized taking into account the experience of project-oriented management.

Materials and Methods

The study on the chosen topic of substantiation of the organizational structure of the management system in higher educational institutions was conducted in three stages. In particular, during the first stage of scientific exploration, the analysis of the current state of organization of scientific project management in higher education institutions within the Ukrainian scientific space was conducted to identify the problematic aspects of scientific and technical activities that require qualitative and effective solutions. The second stage of scientific research provided for the creation of a model of effective scientific project management in higher educational institutions based on the analyzed problem field, the essence of which was a combination of quantitative, temporary and financial factors of the organization of a scientific-educational project. The third stage of scientific research was aimed at analyzing international practices of managing scientific projects focused on cooperation with individual enterprises of the economic sphere, in order to establish correlative links with Ukrainian practices and search for methods of possible further cooperation within the scientific and practical space.

Achieving this goal of scientific research made it possible to apply general scientific research methods of theoretical and practical directions. In particular, the method of analysis was used during the analysis of scientific and methodological literature of Ukrainian, European and American researchers on the topic of methodology for managing scientific projects, which made it possible to form a characteristic of the current state of research of the problem. The synthesis method helped to combine the results of the process of analyzing the theoretical base of research in the form of literature sources, as a result of which a key problem of scientific and technical activity was identified, the essence of which is the need to commercialize the results of scientific and technical activities. Using the comparison method, common and distinctive features in the management of scientific projects of higher educational institutions within the Ukrainian and global educational space were identified. The generalization method was used to summarize the results of the study in accordance with the conducted theoretical

Results and Discussion

Commercialization of the results of scientific and technical activities as an element of scientific project management

and empirical research, highlighting recommendations for improving the process of managing scientific projects through international cooperation, attracting financial resources from external sources, as well as creating a body for commercializing the results of scientific and technical activities. Through the structural method and the method of systematization, a vertical of management in the system of higher educational institutions was formed, as well as the structural scheme of the subsystem of management of dual-use scientific products was recreated. The mathematical method, as well as the modeling method, contributed to the creation of an approach to solving the problem of optimal planning of a scientific project, which provided for the design of an effective model for managing scientific projects in higher educational institutions in accordance with the criteria of quantity, time and financial resources. The use of the above-mentioned methods of scientific research in accordance with the principles of structural, functional and system approaches ensured the achievement of the goal of scientific research, taking into account a number of economic factors of scientific and technical activities.

At the same time, the research on the selected issues required a detailed analysis of the legislative and regulatory framework of Ukraine to determine the legal aspects of potential scientific and technical activities within the current legislation, so the work used the key positions specified in the Law of Ukraine "On Scientific and Scientific and Technical Activities".

It is worth starting with the fact that the integration of scientific, scientific and technical and innovative activities of higher educational institutions and scientific institutions of the National Academy of Sciences of Ukraine, as well as national branch Academies of Sciences and institutions of higher education of Ukraine is carried out to develop and implement priority scientific programs, research, experimental developments, etc., based on the combination of personnel, financial, technical and organizational resources in accordance with current legislation. For the proper functioning of research processes in scientific organizational structures, including in scientific and pedagogical departments of higher educational institutions, a clear organizational and staff structure and a hierarchical vertical of management are formed [9]. However, some cases (namely the execution of scientific projects) require a certain opportunity to depart from a predetermined hierarchical structure with the decisive role of the top manager in decision-making. This approach focuses on a flexible network system, within which authority is delegated to the project supervisor (Fig. 1). The ability to manage a science unit (a team of scientific project performers) as a dynamically managed organism with free communications has a positive effect on avoiding the spread of false information between project departments, reducing the burden on the top manager and significantly reducing the time limits for reaction and response from the manager.

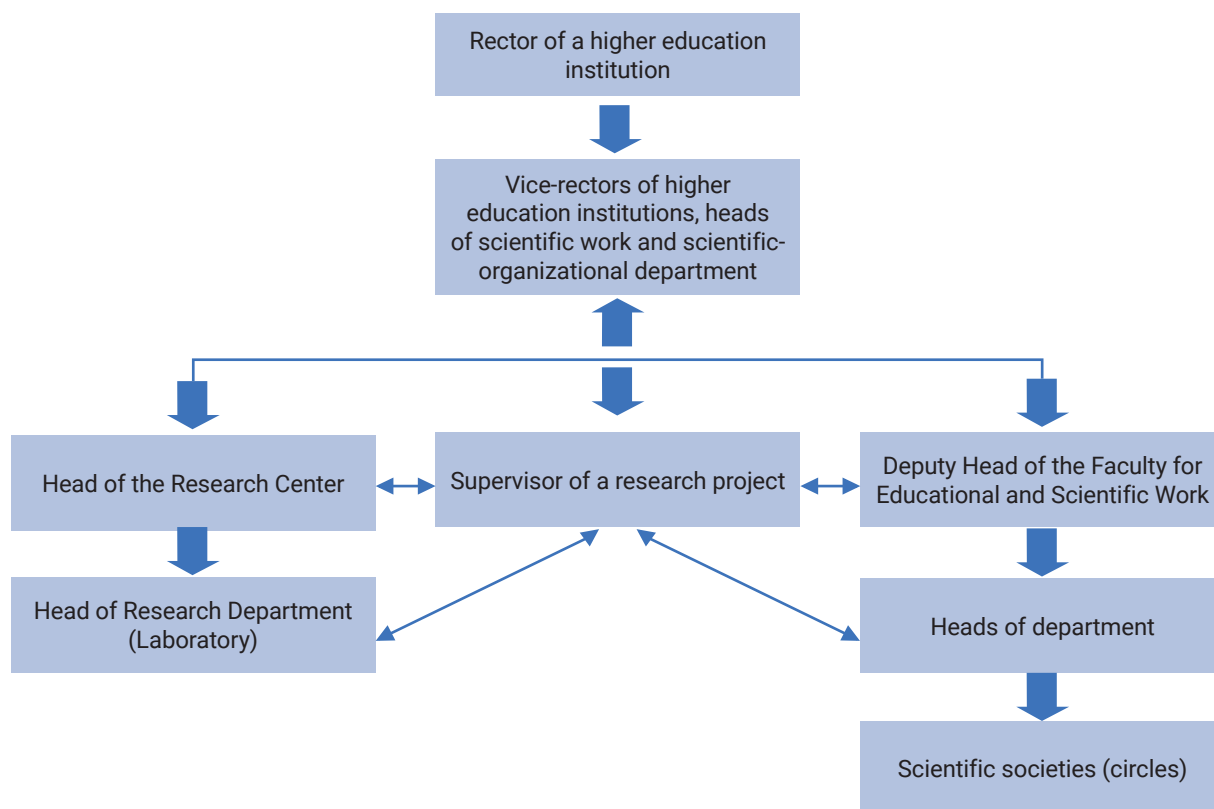


Figure 1. Vertical management in the system of higher education institutions

An important condition for the development of scientific educational potential in the field of realization of scientific projects is the availability of sufficient financial support. According to it in the system of management of higher education institution the mechanism of commercialization of results of scientific and technical activity should be realized [5]. It will promote attraction of additional financial resources, as well as restore the effectiveness of further scientific activities. Therefore, in addition to the Ministry of Education and Science of Ukraine, law enforcement agencies of the state, departmental national universities, specialized higher educational institutions and, for the most part, enterprises whose activities are directly related to meeting the needs of higher educational institutions [10] may be interested in obtaining scientific knowledge.

In this context, the question arises of the expediency of “hiding” the full scope of scientific research results in the economic sector. According to the totality of indicators defined by regulatory legal acts of the state regarding information with restricted access, a certain number of results of scientific and technical activities does not contain signs of state secrets. It is proposed to introduce an analytical and permissive management body into the mechanism of managing scientific and technical activities, which will determine the possibility of sectoral removal of restrictions on access to documents for official use and to state secrets, that is, access to general scientific databases of certain parts, stages of scientific research, developments, methods that can be used as dual-use products in the interests of, first of all, the Ministry of Education and Science of Ukraine,

through organizations that have received state funding from the defense budget, as well as for scientific institutions of other ministries (departments), institutions and business [10].

The initial stage of publication of the results of scientific projects is carried out using the accounting and reporting element of the automated scientific and technical information system in the public network. This means that open databases may publish not the result of scientific and technical activity itself, but its description, direction, certain characteristics, features, algorithms and techniques. The specified project management element should be a structural element of the scientific and technical activity management system (Fig. 2), as well as perform the function of mediation between the supplier of the results of scientific and technical activities (i.e. goods) – science units of organizations and institutions, and the consumer of this product – organizations that are interested in certain scientific developments. In such a model, the question of the cost of transferring (buying) scientific results immediately arises. Today, there are no effective mechanisms for attracting non-state funds to ensure the scientific and technical activities of the education sector, and the implementation of the proposed scheme will improve the level of financial support. This will also additionally load researchers and, accordingly, the entire scientific component, will become an additional factor in the rapid development of scientific and technical activities, will contribute to the flexibility of science and its adaptation to modern conditions of technology development and market relations.

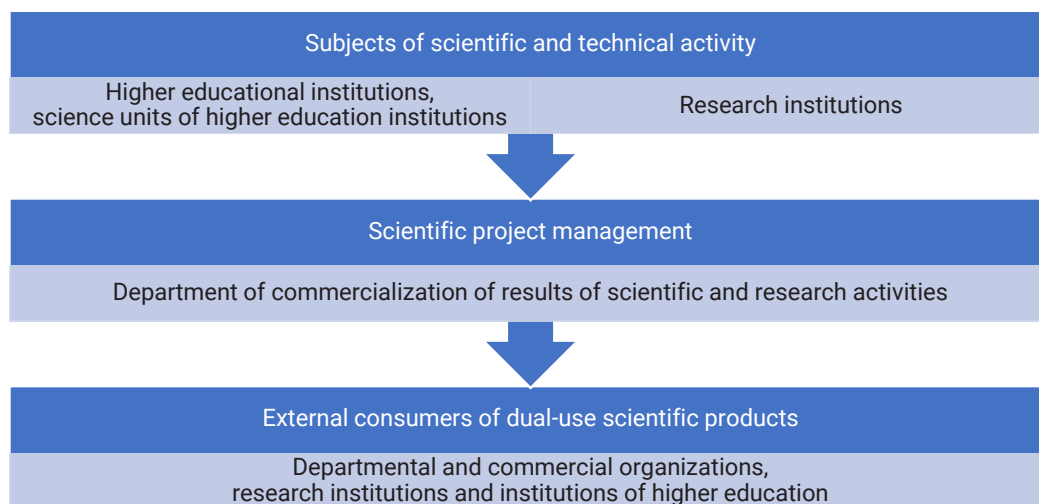


Figure 2. Block diagram of the dual-use scientific product management subsystem

Finally, it should be added that the need for commercialization of the results of scientific and technical activities is determined by the following functions of the body:

- inventory of the results of scientific and technical activities;

- formation and maintenance of a database of scientific and technical activity results;
- providing consulting services in the field of technology commercialization;
- identifying the commercial attractiveness of developments;

- streamlining issues of intellectual property of the results of scientific and technical activities;
- attracting funding from state-owned corporations and private investors [11].

Model of scientific project management in higher education institutions

In accordance with the above, the authors propose an approach to solving the problem of optimal planning of a scientific project, which can be used as a management tool to solve the problems of the commercialization unit of the results of scientific and technical activities. Therefore, the economic and mathematical model of solving this problem is described as follows. The following designations are used:

m – number of scientific projects in the planned time period;

n – the number of intervals into which the planned time period is divided;

n_i – the number of intervals during which i – project can be performed, where $i = \overline{1, m}$;

Q_i^P – set of sequence numbers of time intervals in which funding i – project is required, provided that its implementation begins within the first time interval; $Q_i^P \subseteq \{1, \dots, n_i\}; i = \overline{1, m}$;

Q_i^D – the set of serial numbers of time intervals in which it is expected to receive income from the implementation of the i – project, provided that its implementation begins with the first interval; $Q_i^D \subseteq \{1, \dots, n_i\}; i = \overline{1, m}$;

P_{ik} – the number of financial investments provided for i – scientific project on the k – time interval for its execution; $i = \overline{1, m}; k \in Q_i^P$;

D_{ik} – the amount of income from the implementation of the i – research project on the k – time interval of its implementation; $i = \overline{1, m}; k \in Q_i^{Pr}$;

Variable x_{ik} is introduced. If i – scientific project is accepted for execution, starting from k – time interval, then $x_{ik} = 1$, if not accepted, then $x_{ik} = 0$.

$$x = (x_{ik} | i = \overline{1, m}; k \in N_i), \quad (1)$$

where N_i – set of time interval numbers during which implementation of i – project can be started; $N_i \subseteq \{1, \dots, n - n_i + 1\}; i = \overline{1, m}$.

Profit from the implementation of the i research project – the difference between income and costs of implementation:

$$b_i = \sum_{k \in Q_i^D} D_{ik} - \sum_{k \in Q_i^P} P_{ik}. \quad (2)$$

The target function is obtained:

$$f(x) = \sum_{i=1}^m b_i \sum_{k \in N_i} x_{ik}. \quad (3)$$

The necessary conditions are set, such as:

1. $b_i \geq a_k$, where a_k – the minimum allowable level of profit in k – time interval, $k = \overline{1, n}$;
2. Restrictions for multiple numbers of scientific projects that may require funding in k – time interval;

3. Restrictions for multiple numbers of scientific projects, which, if funded, can bring profit in k – time interval, etc. [12].

This way the perspective model of management of scientific and technical activity of higher education institutions of Ukraine has been built, which contains optimized models and methods of management, takes into account the changes of organizational and structural nature in the existing system of scientific and technical activity in higher education institutions of Ukraine [6]. It should be noted that the organization of joint scientific research of higher educational institutions of Ukraine with Ukrainian scientific institutions has an extensive system of scientific departments that work on the development of science. In particular, the main role in the system is played by the National Academy of Sciences of Ukraine (NAS). A modern experimental and production base has been created in scientific institutions of the National Academy of Sciences. The Institutes of the National Academy of Sciences of Ukraine carry out fundamental research that solves the main problems of natural, technical and social sciences, as well as conduct applied research. Unlike academic research institutes, industry research institutes are mainly engaged in applied research, the purpose of which is to develop new technologies, improve and create new models of equipment for the relevant industries [13]. Therefore, the main areas of integration of scientific, scientific and technical, innovative activities of higher education institutions and research institutions of the NAS, national branch academies of sciences of Ukraine can be [8]:

- participation in the development and implementation of state targeted programs;
- conducting joint scientific research, experimental and innovative developments, etc., in particular at the expense of the state budget and own revenues;
- participation in the creation of scientific and educational, research associations, innovative structures and other organizational forms of cooperation;
- introduction of jointly created innovative products into production in the interests of the military industry etc;
- ensuring the acquisition of protection of intellectual property rights to the results of scientific and technical activities;
- implementation of joint publishing and information and resource activities;
- engagement by institutions of higher education of researchers from the NAS, national branch academies of sciences and organizations of scientific and pedagogical workers of higher educational institutions on the basis of an employment contract (agreement) for the implementation of educational and scientific activities, in particular for the training of postgraduates and doctoral students, preparation and examination of textbooks, manuals, educational programs and standards of higher education to support the educational process in higher education;
- organization of scientific research of young scientists,

doctoral students and postgraduates on the basis of the NAS, national branch academies of sciences and institutions of higher education of Ukraine, systematic industrial practice of students of higher education institutions with their direct participation in conducting scientific research [14].

Organization planning and implementation of joint scientific research in higher educational institutions with NAS institutions is carried out on the basis of an agreement in the following areas:

- organization of implementation of the achieved results of NAS institutions based on the results of the implementation of the target scientific and technical program of the academy "Research and Development on Problems of Increasing the Defense Capability of the State";
- preparation of proposals on the implementation by institutions of the NAS in the calendar year of applied research needs of education in Ukraine and their inclusion in the state defense order.

International cooperation in the management of educational projects of higher educational institutions

It is worth noting that there are many ways of international scientific and scientific-technical cooperation [15]. In the context of optimizing the management of educational projects, it is necessary to pay attention to the following:

- conducting joint scientific research, technical and technological developments on the basis of cooperation, joint scientific and technical programs, coordination agreements;
- carrying out the work stipulated in the agreement, one party to which is an organization of a foreign state or an international organization;
- conducting joint research and development with international teams of specialists, international institutes and joint ventures, using ownership rights to scientific and technical (applied) results on the basis of agreements between subjects of scientific and technical activities;
- mutual exchange of scientific and technical information, use of joint international information funds, data banks;
- conducting international conferences, congresses, and symposia;
- mutual exchange of scientific, scientific-technical and scientific-pedagogical personnel, students and postgraduates, as well as joint training of specialists;
- participation in international research programs, in particular, the EU Framework Programmes for Research and Innovation

Economic entities of scientific and technical activities may participate in the implementation of international scientific and technical programs and projects, also enter into agreements with foreign organizations and legal entities, participate in foreign and international scientific societies, associations and unions as their members, enter into contracts with foreign organizations and legal entities, participate in international symposia and other events in accordance with the laws of Ukraine [8]. The state ensures the integration of the national research space into the European

research space by implementing its priorities, in particular improving the effectiveness of the national research system; optimizing international cooperation in order to solve global problems facing humanity; ensuring participation in the EU framework and joint international programs; coordinating the strategy for creating state research infrastructures with the roadmap of European research infrastructures; creating favorable conditions for the mobility of scientists; full exchange, transfer and access to scientific knowledge [16].

At the same time, it should be noted that the system of scientific and technical activities of the world's leading countries is based on the principles of dynamism and proactivity in order to avoid obsolescence and compliance with scientific and technological progress. For example, to facilitate close ties with academia, industry, and the innovative private sector, the *Army Futures Command* (AFC) headquarters (a component responsible for advanced military research for the US Army) was located on the campus of the University of Texas [17]. There are 8 multi-functional teams working within the AFC (*Cross-Functional Teams*, CFT), which develop requirements obtained through experiments and technical demonstrations for a number of priority areas of ability development, such as: synthetic learning environment [18].

As a result of the conducted analytical research, the outline of a promising model of scientific and technical activities of higher educational institutions of Ukraine is created, as well as the main directions of applying efforts to improve the efficiency of the system of scientific and technical activities are formulated, namely:

- in the general structure of the system of scientific and technical activities of higher educational institutions of Ukraine, it is proposed to introduce state bodies of control and coordination of science, as well as mandatory integration with the Ukrainian and world scientific and technical environment, enterprises. In particular, in this context, it was a question of granting real powers and registration as a full-fledged element of the system of providing scientific and technical activities to ensure the already existing system of these activities;
- proposals are made to include in the structure of the scientific and technical activity management system the commercialization body of the results of scientific and technical activities, which will improve the level of financial support, additionally load the scientific component, and also contribute to the flexibility of military science and its integration into the scientific, technical and industrial environment. An approach to solving the problem of optimal planning of scientific projects is proposed.
- recommendations on the shift from the rigid hierarchical structure and granting additional authority to heads of scientific projects in higher educational institutions in terms of managing scientific projects are substantiated.
- recommendations have been developed to involve the personnel of science units in international cooperation, participate in events for the exchange of experience, and

create mixed working groups in events of scientific and technical cooperation and interaction.

Conclusions

In the course of research, based on the analysis of the existing management system of scientific and technical activities, world and national experience in this field, the main directions of effective improvement of scientific project management is determined. It is established that the state provides subjects of scientific and technical activity with the necessary legal and economic conditions for carrying out further activities and establishing relations based on cooperation with scientific and scientific-technical organizations, as well as enterprises of national and international level. In the context of improving the efficiency of scientific project management, the author provides advice on organizing joint international scientific research. It is

revealed that the existing methodological apparatus does not provide comprehensive tools for fully supporting the tasks of managing scientific projects in higher education institutions. Taking into account the studied features and specifics of scientific projects in the education sector, resources, activities and processes are identified, the impact on which optimizes the management of scientific projects in higher educational institutions, a list of management models and methods is formulated that reveal in more detail the content of scientific projects and management processes in them, give managers of scientific and technical activities in higher educational institutions additional opportunities and levers of influence on the project. Prospects for further research are seen in the practical implementation of the developed model of managing scientific projects within the activities of higher educational institutions for experimental confirmation of its effectiveness.

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Модель обґрунтування організаційної структури системи управління закладів вищої освіти

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Анотація. Актуальність дослідження визначається потребою в оновленні структури управління науковими проектами в межах закладів вищої освіти відповідно до сучасних економічних реалій і міжнародно визнаних стандартів, суть якого полягає у відході від жорсткої ієрархічної системи управління та орієнтації на комерціалізації результатів науково-технічної діяльності. Відтак, метою наукової статті є розроблення функціональної моделі управління науковими проектами в межах вищої освіти, складові якої, на відміну від наявних моделей, будуть характеризуватися проектно-орієнтованим спрямуванням. Для досягнення визначеної мети дослідження використовувались загальнонаукові методи дослідження, серед яких аналіз, синтез, узагальнення, порівняння, систематизація, моделювання, а також структурний і математичний методи, з урахуванням ключових принципів структурно-функціонального та системного підходів. У статті проаналізовано низку наукових праць українських і зарубіжних вчених із теми методологічного обґрунтування специфіки управління науковими проектами у вищих навчальних закладах. Визначено ключові проблеми сучасного стану управління науковими проектами в межах українського наукового простору, зокрема жорстку організаційно-штатну структуру управління з переважною роллю вищого керівника, недостатнє фінансове забезпечення науково-технічної діяльності, а також обмежений доступ до результатів науково-технічної діяльності. Розроблено авторську економіко-математичну модель управління науковими проектами в закладах вищої освіти з урахуванням функціональних показників. Запропоновано впровадження органу комерціалізації результатів науково-технічної діяльності, який сприятиме оптимізації фінансового забезпечення науково-технічної діяльності. Обґрунтовано необхідність у розвитку міжнародного співробітництва в межах науково-технічної діяльності та організації наукових проектів зокрема. Практична цінність наукової роботи полягає в розробленні власного методичного забезпечення належного функціонування управління науковими проектами з перспективою його подальшого застосування на практиці

Ключові слова: економічна модель, науковий проект, вищі навчальні заклади, науково-технічна діяльність

Cross-Spectral Analysis of Long-Term Economic Cycles

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Abstract. One of the problems of studying economic cycles, namely long-term ones, is the choice of an adequate method that allows identifying and explaining the nature of the economic cycle according to available statistical data, which subsequently becomes the basis for predicting future economic dynamics. In addition, questions remain open not only concerning the establishment of the duration of Kondratieff cycles, but also the very fact of their existence. For this purpose, the study investigated time series of annual GDP per capita growth rates for such countries as England, France, and the Netherlands for 1820-2015. In this paper, the cross-spectral analysis approach was developed as a modelling tool for identifying long waves, the use of which, in contrast to classical Fourier spectral analysis, allows investigating the periodicity of two interrelated time series simultaneously in the frequency and time domains. As a result of the analysis, coherence and phase shift graphs were constructed for the investigated time series, which became the basis for identifying and determining the duration of economic cycles of different periods. According to the obtained results, it was found that all selected time series have a high coherence value (within the range of 0.8-0.9) in the frequency domain corresponding to K-waves with the period of 38-55 years (in the frequency range 0.025-0.015). At the same time, a slight phase shift was obtained for the frequency range corresponding to long cycles, which is an empirical confirmation of the synchronisation of the investigated time series. These facts are an additional argument for empirical confirmation of the existence of long waves. The practical significance of this study is that the identification of multi-period cycles using the proposed approach allows developing and implementing adequate counter-cyclical measures to timely regulate economic development at both the macro- and meso-levels

Keywords: co-spectrum, Kondratieff cycles, long waves, frequency range, coherence, phase shift

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Introduction

Due to increased globalisation at the present stage of development of the world economy, negative trends have considerably worsened, as evidenced by the growing number and intensity of both regional and global financial and economic crises. One of the reasons for the emergence of crisis phenomena is the cyclical development of the economy, which manifests itself in periodic changes in the phases of upswing and downswing. The increase in instability and crisis phenomena leads to growing interest in researchers' interest in theoretical justification and empirical analysis of the problem of the origin of cyclical and crisis phenomena.

Economic cycles lasting 7-11 years, expressed in rapid ascents and crises that suddenly engulf society, have become an integral part of progressive development. However, against the background of these cyclical fluctuations, cycles of a different duration, namely long cycles of 40-60 years, were also less clearly, but very noticeably visible. Analysis of long economic cycles helps understand the long-term dynamics of the global economy, allows making forecasts, and it is also the basis for understanding past crises and current global economic instability. Therefore, the study of the features of cyclical economic development by using statistical approaches is one of the essential components of developing effective counter-cyclical measures to regulate economic development at both the regional and macro levels. Thus, the problem of theoretical justification, diagnostics, and identification of economic cycles, in particular using economic and mathematical models and tools, is still relevant today. At the same time, one of the problems of studying economic cycles, especially long-term ones, is the choice of an adequate method that allows identifying and explaining the nature of the economic cycle according to available statistical data, which subsequently becomes the basis for predicting future economic dynamics. Another problem is the lack of statistical representative time series data of the required length, which complicates the analysis and reliable estimation.

Analysis and modelling of economic cycles, specifically their identification and detection of multi-period fluctuations by analysing time series of GDP, price indices or other indicators, is predominantly based on the use of statistical methods, in particular spectral analysis. Therewith, the focus of researchers' attention is primarily on short-term business cycles (1-2 years) and medium-term Juglar cycles (7-11 years) [1; 2]. However, as for long cycles (with a periodicity of 40-60 years), the concept of which was proposed by Kondratieff [3] and developed by Schumpeter [4], the use of classical spectral analysis does not guarantee (with sufficient reliability, probability, validity) to confirm the existence of long waves and to carry out their periodisation [5-7], which requires the use of other, more powerful methods and research tools [8].

To ensure the regulation of the economic state of countries and timely response to the onset of crisis phenomena and prevent their consequences, there is a need to use an adequate forecasting approaches and methods to

identify the nature of cyclical occurrence and assess the dynamics of wave processes, namely for the medium and long term. Therefore, *the purpose of this study* is to diagnose and identify long waves in the economy by analysing time series of annual GDP per capita growth rates for 1820-2015 for three countries (England, France, the Netherlands) using the cross-spectral analysis methodology, which is a generalisation of the classical Fourier spectral analysis for the case of two time series.

Literature Review

Many studies cover the analysis of modern theoretical concepts of the emergence of long waves (K-waves) in economics and the main provisions of Kondratieff theory and alternative concepts of long waves [9; 10]. The main conclusion of the authors of these studies is that despite the wide variety of proposed theories, none of them allows fully explaining the causes of cyclical behaviour yet, determining the factors and time of onset of global economic crises and recessions, ways to overcome them, etc. [11; 12]. Economic cycles (namely long- and medium-term) are a multidimensional phenomenon that requires further comprehensive, systematic analysis of the processes that generate long- and medium-term fluctuations, concurrently considering macroeconomic, investment, innovation, technological, social, and political aspects.

The study [8] provides the results of spectral analysis of the time series of GDP per capita to determine the duration of Juglar, Kuznets, and Kondratieff cycles, identify and explain the nature of the economic cycle based on available statistical data. As for long economic cycles, the results of the spectral analysis performed in this study do not allow unambiguously identifying them, their corresponding harmonics have considerably smaller amplitudes than for medium-term cycles [8].

The study [13] considers the issues of research and modelling of Kondratieff long waves. A compact mathematical model of cyclical dynamics is constructed, describing the trajectory of GDP depending on the dynamics of investment, consumer demand and profit, and it is also concluded that the model, apart from a qualitative analysis of the impact of long waves on long-term growth, allows jointly describing long-term cyclical fluctuations imposed on the trend component, estimate the duration of cycles, etc.

To identify Kondratieff cycles, the authors of [14] used the cross-spectral analysis technique of economic growth for the USA, Germany, England, and France. As a statistical basis for the study, the researchers used annual data on GDP per capita and data on patent activity for 1883-2010. The obtained results indicate the existence of long waves in the selected countries with a frequency of 32-64 years, which is too wide a range that the most researchers do not agree with.

To identify long cycles more reliably, the authors of [15] conducted a spectral analysis of the dynamics of world GDP (for 1870-2007) using an improved method for statistical estimation of selected waves. This analysis

allowed assessing the statistical significance of K-waves in the dynamics of global GDP and demonstrated their presence at an acceptable level.

On the other hand, the results of studies [4; 6; 7] indicate that the use of both spectral analysis [6; 7] and ARIMA time series models [4] does not allow stating the existence of long waves in the rates of world economic growth with statistically significant reliability (England's GDP for 1830-2006). Therefore, the problem of identifying long waves in the economy requires further study.

Materials and Methods

Mathematical tools for cross-spectral analysis were used to identify long waves [16]. Unlike spectral analysis, the use of cross-spectral analysis allows investigating the periodicity of two interrelated time series simultaneously.

The first variable is represented as independent, and the other is dependent. Based on the cross-periodogram (its real and imaginary parts), one can calculate the values of coherence (correlation of time series in the frequency

domain) and phase spectrum (synchronisation of time series). If the time series under study are synchronised and have peaks at low frequencies, then this is an additional argument for the presence of long waves.

Cross-spectral analysis allows investigating the presence of substantial harmonics in time series and estimate the tightness of the relationship between these series based on the determination of coherence and phase for pairs of the original series. Cross-spectral analysis constitutes a generalisation of spectral analysis for the two-dimensional case and comes down to the calculation of two spectral functions: the mutual and quadrature spectra [17].

On a complex plane, the eponymous components are directed along the same axis, and heteronymous components are directed along mutually perpendicular axes [17], the function of $p(\omega_j)$ is called the co-spectrum. In the graph, the co-spectrum or co-spectral density is the real part of the cross-periodogram that determines the correlation measure and is in the same phase of the frequency components of the two time series.

$$p(\omega_j) = \lambda_0/4\pi[C_{xy}(0) + C_{yx}(0)] + 1/2\pi \sum_{k=1}^m \lambda_k [C_{xy}(k) + C_{yx}(k)] \cos \omega_j k \quad (1)$$

where λ_0 is the calculated moving value; C_{xy} and C_{yx} are covariance functions, the values of which depend on the choice of estimates.

The function $q(\omega_j)$ is called the quadrature spectrum. A quadrature spectrum is the imaginary part of the

$$q(\omega_j) = 1/2\pi \sum_{k=1}^m [C_{xy}(k) + C_{yx}(k)] \sin \omega_j k; \quad \omega_j = \pi j/m; \quad j = 0, 1, \dots, m \quad (2)$$

One of the essential features of the common characteristics of two time series is the concept of mutual power spectrum or cross-spectrum. The basis of the cross-spectrum is complex numbers divided into real and imaginary parts, which are described by the interaction (consistency, interdependence, etc.) at different frequencies of two stationary time series. To estimate the cross-spectrum, a periodogram or cross-periodogram is constructed – a graph of the dependence of the spectrum amplitude on the frequency or period. Low oscillation frequencies determine smooth series. “White noise” is defined by a uniform spread of deviations over all frequencies. Theoretically, “white noise” refers to time series, the levels of which have zero mean, constant variance, and zero autocorrelation.

Methods similar to conventional spectrum estimation methods are used to estimate the mutual spectrum [18]. The power spectrum is the modulus of the mutual spectrum, and the argument is the phase or phase spectrum. The phase spectrum is a measure or degree to which each frequency component of one series is ahead or behind another. If there is a correlation within the frequency range, then estimating the phase in the power spectrum is also informative.

Writing two discrete sequences of real numbers in

cross-periodogram that determines the correlation measure and is not in the same phase of the frequency components of the two time series. The phase shift is $\pi/2$ radians.

the following form

$$x_k = x(t_k), \quad t_k = \Delta t_k, \quad k = 0, 1, \dots, N-1, \quad (3)$$

$$y_k = y(t_k), \quad t_k = \Delta t_k, \quad k = 0, 1, \dots, N-1, \quad (4)$$

allows writing the function of a mutual periodogram or a cross-periodogram of series x_k and y_k as follows:

$$D_{xy(\omega)} = \frac{1}{N^2} X(\omega) Y(\omega) \quad (5)$$

where:

$$X(\omega) = \sum_{k=0}^{N-1} x_k e^{-i2\pi\omega t_k} \quad (6)$$

$$Y(\omega) = \sum_{k=0}^{N-1} y_k e^{-i2\pi\omega t_k} \quad (7)$$

To obtain estimates of cross-density and quadrature density, smoothing of the sample mutual periodogram is used to remove high-frequency and seasonal fluctuations from them, for instance, using the Parzen window. In the Parzen window [19], for each frequency, the weights for the weighted moving average of the periodogram values are calculated as follows:

$$w_j = 1 - 6(j/p)^2 + 6(j/p)^3 \text{ (for } j = 0 \text{ to } p/2) \quad (8)$$

$$w_j = 2(1 - j/p)^3 \text{ (for } j = p/2 + 1 \text{ to } p) \quad (9)$$

$$w_{-j} = w_j \text{ (for } j \neq 0) \quad (10)$$

or the Bartlett window [20]:

$$w_j = 1 - (j/p) \text{ (for } j = 0 \text{ to } p) \quad (11)$$

$$w_{-j} = w_j \text{ (for } j \neq 0) \quad (12)$$

In the previous study [8], the authors used the Hamming window to smooth the periodogram.

The square root of the sum of the squares of the values of the co-spectral density and the quadrature spectrum is called the cross-amplitude.

$$A(\omega_j) = \sqrt{p^2(\omega_j) + q^2(\omega_j)} \quad (13)$$

The cross-amplitude is defined as a measure of the covariance between the corresponding frequency components of two series. The cross-spectrum presented in Figure 1 determines the presence or absence of harmonic components in the time series under study.

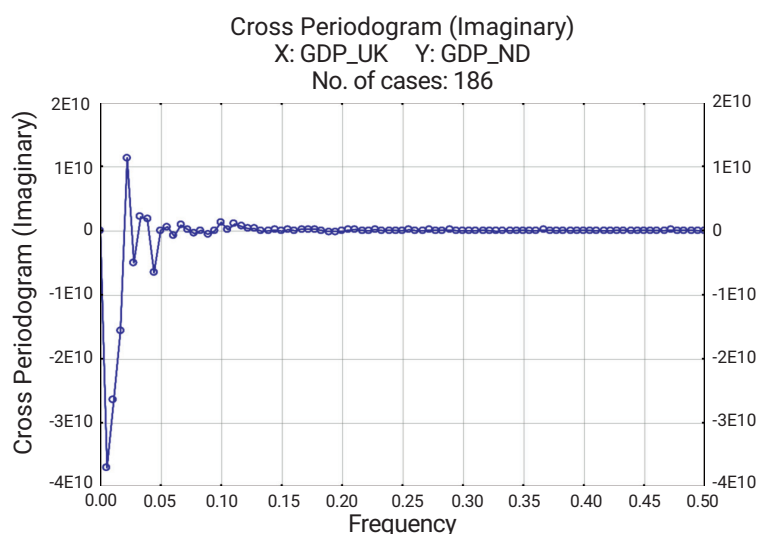


Figure 1. Cross-spectrum GDP of England and the Netherlands for 1820-2015

Source: developed by the author based on [21]

The coherence function $C(\omega_j)$ for two time series is calculated as the ratio of the power spectrum, i.e., the modulus of the mutual spectrum, to the square root of the product of the individual spectra of both series $f_x(\omega_j)$ and $f_y(\omega_j)$, respectively:

$$C(\omega_j) = \frac{p(\omega_j)^2 + q(\omega_j)^2}{f_x(\omega_j)f_y(\omega_j)} \quad (14)$$

It describes the correlation between two series in the frequency range ω_j , that is, it determines the strength of the interrelation between the series. The values of the coherence function, as well as the correlation coefficient, vary in the range from 0 to 1.

The phase shift is an analogue of the cross-correlation coefficient upon estimating the relationship between harmonic components, factoring in their time shift, and has the following form:

$$f(\omega) = \arctg[q(\omega)/p(\omega)] \quad (15)$$

Results and Discussion

For cross-spectral analysis, time series of annual GDP per capita in constant prices in 2009 for 1829-2015 were

selected for such countries as England, France, and the Netherlands (186 observations) according to the information of the Madison research project [22]. The software implementation of cross-spectral analysis was performed using the Statistica-10.0 software.

To ensure stationarity, all time series were converted to growth rates (year-on-year). Furthermore, the series was smoothed out by a moving average of the 5th order, which allows avoiding high-frequency noise – in the case of this study, to level out short-term business cycles.

As a rule, during spectral analysis, the focus is on the analysis of periodogram graphs and spectrograms [16]. The results of studies involving spectral analysis [4; 6; 7] do not allow drawing an unambiguous conclusion about the presence of long waves.

Notably, in contrast to spectral analysis, when conducting cross-spectral analysis (in the case of a scientific study of two time series), it is advisable to construct coherence and phase spectrum diagrams to investigate the interaction indicators of processes in different frequency domains (Figs. 2-4). In these graphs, the frequency of vibrations is plotted along the abscissa axis.

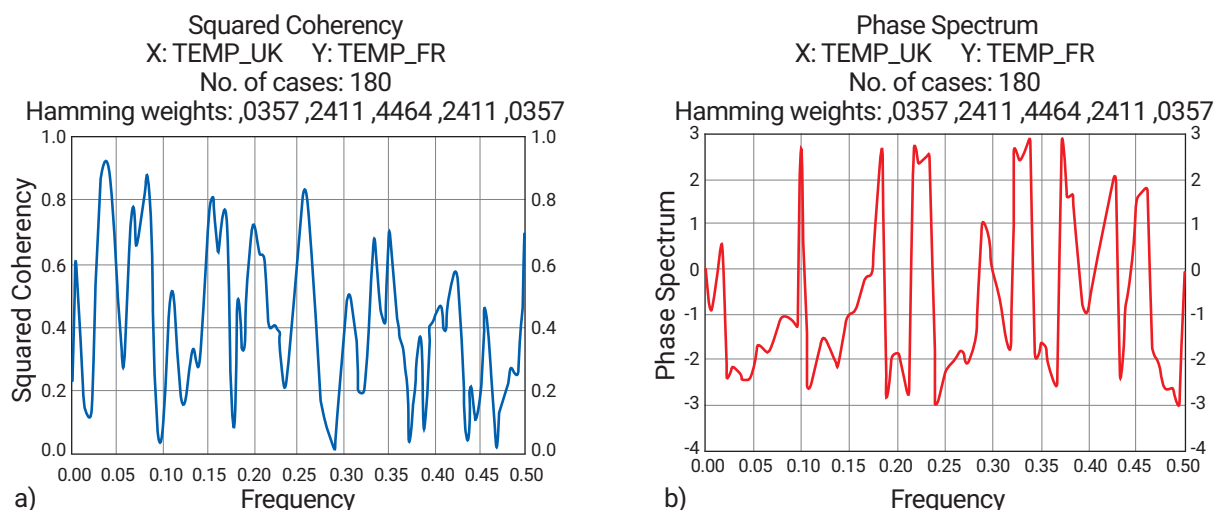


Figure 2. Coherence diagram (a) and the time series phases (b) of GDP growth rates in England and France for 1829-2015

Source: developed using author's calculations based on data [22]

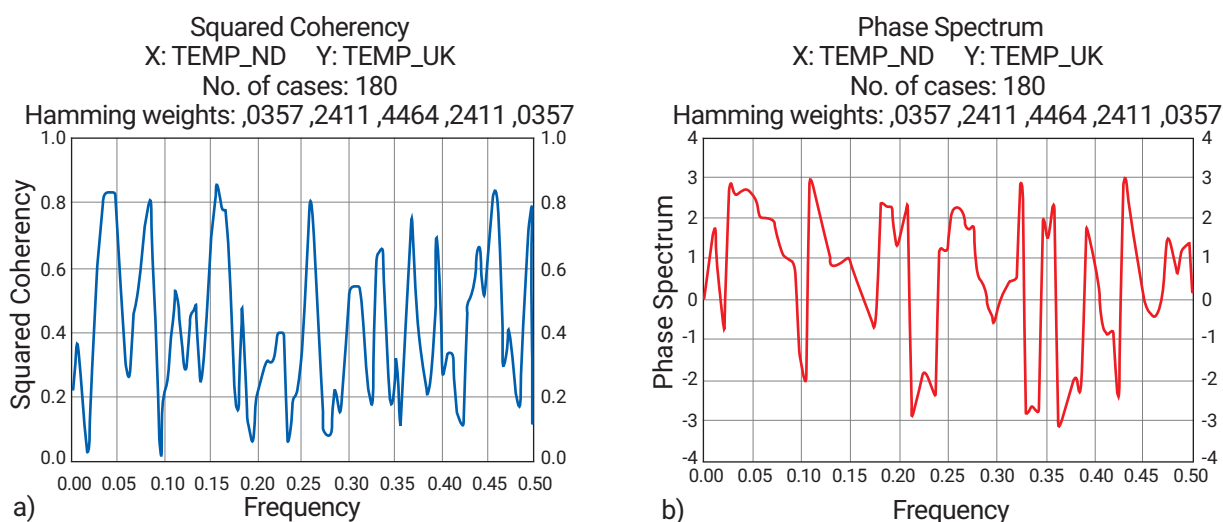


Figure 3. Coherence diagram (a) and the time series phases (b) of GDP growth rates in the Netherlands and England for 1829-2015

Source: developed using author's calculations based on data [22]

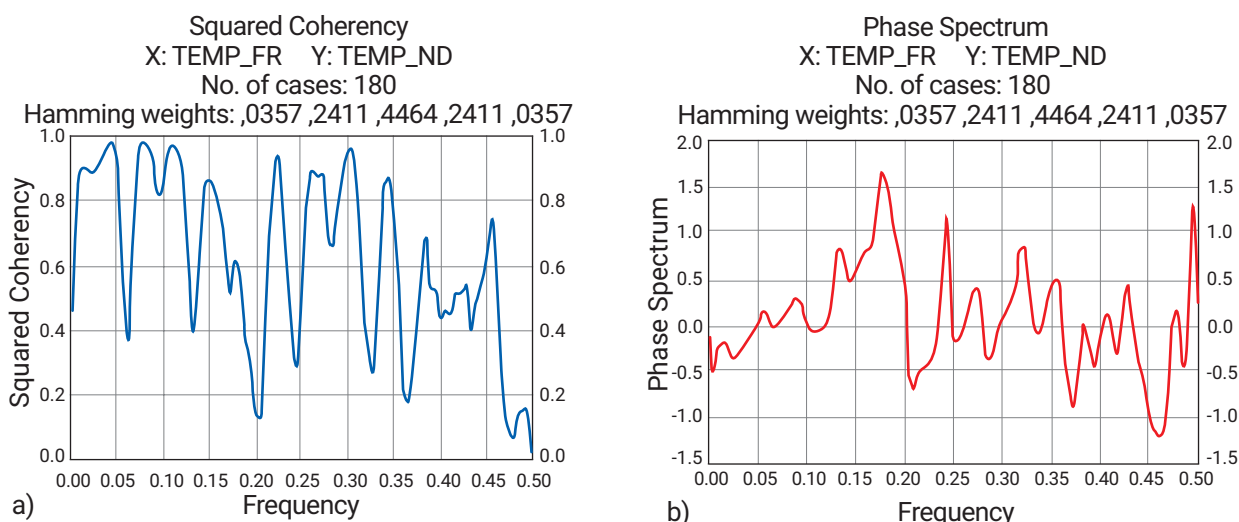


Figure 4. Coherence diagram (a) and the time series phases (b) of GDP growth rates in France and the Netherlands for 1829-2015

Source: developed using author's calculations based on data [22]

At the same time, the left part of the diagrams is in the focus of our attention, as it corresponds to the low-frequency range of the spectrum (correspondingly longer periods). According to scientific results of the studies [8; 14; 15], Kondratieff long waves (38-55 years' period) correspond to the frequency range 0.025-0.015. Chart analysis (Fig. 2(a), 3(a), 4(a)) indicates the presence of high coherence between all the time series: 0.92 (England-France); 0.83 (England-Netherlands); 0.88 (France-Netherlands) in the frequency range corresponding to long waves.

Furthermore, the analysis of coherence diagrams allows reliably identifying shorter cycles: Kuznets swing (frequency range 0.055-0.035) and Juglar cycle (frequency range 0.125-0.075) for all investigated series pairs. Thus, on all graphs (Fig. 4-6(a)) there are a clear peaks at the 0.04 frequency for a period of approximately 25 years, which corresponds to the upper limit of the Kuznets swing, which is associated with a massive innovation of basic technologies [2; 10].

As for the Juglar cycles (8-12 years), it is possible to trace peaks in the coherence values for all series at frequencies corresponding to the extreme limits: for 8 and 12 years, respectively (Figs. 2(a), 3(a), 4(a)). Most researchers explain these cycles by fluctuations in the volume of investment in fixed assets [2; 10]. At the same time, for a period of 12 years, the peaks in coherence are lower in amplitude than for 8 years for such series pairs as England-France and England-Netherlands.

Since coherence describes the degree of interdependence (or synchronisation) of time series in the frequency domain, its high value (0.8-0.9) suggests that there are similar dynamic properties in the GDP series of the selected countries over long periods corresponding to the Kondratieff cycles, as well as the shorter Kuznets swing and Juglar cycles. Therewith, a slight phase shift can be observed for the frequency range corresponding to the long cycles (0.025-0.015) (Fig. 2(b), 3(b), 4(b)), which is an empirical confirmation of the synchronisation of the time series of GDP per capita in the most industrialised countries, which are the main generators of long waves in the economy [23].

As for the shorter cycles, there is a clear synchronisation for the France-Netherlands time series (Fig. 4(b)). As for other pairs of the series, such phase synchronisation is no longer observed here: it is present as a leading one (Fig. 3(b)), and delayed, lagging dynamics (Fig. 2(b)) at frequencies 0.05-0.1. However, considerable jumps and phase shift sign changes are observed for the frequency 0.1 (a period

of approximately 10 years). This interesting fact requires further meaningful analysis.

Notably, the scientific results are quite consistent with the study [15]. To perform cross-spectral analysis, the authors of this paper selected two time series for each country (GDP and patent activity series) and analysed their consistency, in contrast to the selected approach, which investigated the synchronisation of time series for different countries in this study.

Conclusions

The cross-spectral analysis of the time series of GDP per capita allows identifying different-period economic cycles more reliably, especially the Kondratieff waves. According to the obtained results, all selected time series have a high coherence value in the frequency domain corresponding to K-waves. At the same time, the authors observed a slight phase shift in the frequency range corresponding to the long cycles, which is an empirical confirmation of the synchronisation of the investigated series. Therefore, these aspects constitute additional arguments for empirical confirmation of the existence of long waves. Furthermore, the analysis of coherence diagrams allows reliably identifying shorter cycles: Kuznets and Juglar for all pairs of series under studies.

Thus, cross-spectral analysis complements the results of studies obtained using spectral analysis approach and allows evaluating and identifying economic cycles of different periods in a more flexible manner. Based on the conducted research, it can be concluded that cross-spectral analysis is one of the promising methods for estimating wave economic dynamics, which allows determining both low-frequency and high-frequency fluctuations due to the localisation of data in frequency-time space, as well as evaluating correlations of long-wave amplitudes.

In summary, the main problem of investigating long waves is the lack of sufficient observations for reliable identification: reliable statistical data have been available since the end of the 18th and beginning of the 19th centuries, which complicates the performance of an objective analysis. For more reliable periodisation of K-waves, the authors of this paper believe that it is necessary to use a broader statistical base of the study, which should cover a larger number of countries (admittedly, those for which there are statistical observations of the required length) and a larger number of economic indicators (price indices, industrial production indices, patent activity, etc.).

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Крос-спектральний аналіз довгострокових економічних циклів

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Анотація. Однією з проблем дослідження економічних циклів, зокрема довгострокових, є вибір адекватного методу, за допомогою якого можливо виявити та пояснити природу економічного циклу за наявними статистичними даними, що в подальшому є основою для здійснення прогнозу майбутньої економічної динаміки, окрім цього відкритими лишаються питання не тільки щодо визначення тривалості циклів Кондрат'єва, але і самого факту їхнього існування. З цією метою в роботі було проведено дослідження часових рядів темпів приросту річного ВВП на душу населення для таких країн, як: Англія, Франція та Голландія (Нідерланди) за період з 1820 по 2015 рр. У роботі як модельний інструментарій ідентифікації довгих хвиль було використано математичний апарат крос-спектрального аналізу, застосування якого, на відміну від класичного спектрального аналізу Фур'є, дає змогу дослідити періодичність двох взаємозв'язаних часових рядів одночасно в частотній та часовій області. Внаслідок проведеного аналізу було побудовано графіки когерентності та фазового зсуву для досліджуваних часових рядів, що є основою для ідентифікації та визначення тривалості економічних циклів різних періодів. Згідно з одержаними результатами було з'ясовано, що усі досліджувані часові ряди мають високе значення когерентності (в межах 0,8–0,9) у частотній області, що відповідає К-хвилям періоду 38–55 років (в діапазоні частот 0,025–0,015). Водночас для частотного діапазону, що відповідає довгим циклам, було одержано незначний фазовий зсув, що є емпіричним підтвердженням синхронізації досліджуваних рядів. Ці факти є додатковим аргументом щодо емпіричного підтвердження існування довгих хвиль. Практична значущість роботи полягає в тому, що ідентифікація різноперіодичних циклів з використанням запропонованого підходу дає змогу своєчасно розробляти та запроваджувати адекватні антициклічні заходи щодо регулювання економічного розвитку як на макро-, так і на мезорівні.

Ключові слова: ко-спектр, довгі хвилі Кондрат'єва, частотний діапазон, когерентність, фазовий зсув

Building a Win-Win Strategy Using Game Theory in a Competitive Environment (Subject to Antitrust Restrictions)

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Abstract. The modern economic space is characterised by the actualisation of such market structure as an oligopoly, which necessitates its proper theoretical and empirical investigation. The aim of the paper is to analyse the use of game theory in the oligopoly market under the said conditions. The theoretical methods are the main scientific methods used in this study, in particular analysis, synthesis, historical and statistical methods. It was determined that the game theory is one of the most important relatively new mathematical theories applied in developing various types of economic models, including market analysis and companies activity strategy formation. It has been confirmed that the game theory is most often applied to oligopoly market analysis i.e. the market in which two or more big players conduct activities. Their decisions influence both the market in general and other “players” income and position in the market by influencing the output price or the volume of output (depending on the model). It is stated that there are many ways to apply game theory as the main theory and to explain the future state of the market, incomes, losses, and producers’ share in the oligopoly market due to different conditions and variables. This paper has reviewed the use of game theory subject to antitrust restrictions and when oligopolistic companies mutually benefit. It was substantiated that quite often in the models generated by economists, the mutual benefit of companies in an oligopoly market implies the existence of collusion between market participants in which companies benefit more than they would under the condition of competition between them (cartel). The practical value of the paper is in the theoretical substantiation of game theories in markets in general and in providing some practical strategies for companies’ operations in markets, which will also be useful for students in their studies and for other scholars of economic disciplines

Keywords: oligopoly, game theory, market analysis, antitrust policy, cartel

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Introduction

In today's global economy, an oligopoly is a frequent type of market structure. Such markets may be cement, oil, gas, cars, non-ferrous or ferrous metals, drinks, etc. This is due to growing concentration in markets, increasing margins, decreasing labour shares, and bigger dominance of large companies in markets and in the world economy as a whole [1]. Although such a process of market evolution within the development of the world economy has its disadvantages (higher product prices and lower output), it is inevitable for many reasons, primarily for the high cost of companies research, which would be impossible in a competitive market due to the small size of companies in it. It is important to note that competition in an oligopoly market is an open question. Some economists consider this market closer to a competitive one because there are several actors in it, while others equate it with a monopoly. A "price competition" that should be in this market is only superficially visible but doesn't exist in reality. Thus, the analysis of oligopoly markets is still important in science.

The oligopoly market analysis is based on game theory, which is a branch of applied mathematics that provides tools for analysing situations in which entrepreneurs (monopolists), called players, make interdependent decisions [2]. It allows economists to predict the behaviour of a company in a number of given scenarios. It explains why companies collude and why they might refuse. It indeed helps economists to find a fair price and sales volume in an oligopoly market under one or another scenario [3]. This is a peculiarity of oligopoly market analysis from other markets. However, this is not the only possibility of its application in economics: today, game theory is also used in the analysis of international negotiations, modification of multilateral regimes, and decision-making in international organisations [4].

In its essence, competition is a struggle between economic actors for the most efficient use of production factors [5]. Its absence is one of the main reasons for the failure of the market mechanism [6]. Therefore, in oligopolistic and monopolistic markets, antitrust policy is used to maintain their greater efficiency. However, its application has always been a difficult task in the oligopoly market due to its structure and nature: this market is monopolised on the one hand and competitive on the other. In addition, each oligopoly market has its own characteristics that affect the character of market players [7]. For example, in the gasoline market, which is a typical oligopoly market, products are fungible and demand is inflexible. At the same time, in the car market, products are similar (but not homogeneous) and demand is less persistent, which changes the rules of the game on the market, and therefore the methods of anti-monopoly policy should change. Nevertheless, the main methods of anti-monopoly policy remain: level limit of monopoly in the market, state monitoring of monopoly and competition, price monitoring (prohibition of monopoly prices), and supporting the preservation of competition in the market [8].

Thus, the relevance of the paper is in the analysis of the oligopoly market that is prevalent in the world economy. The article aims to model an action strategy of entrepreneurs ("players") in the competitive oligopoly market, under antitrust restrictions. With the help of the model, it will be possible to better understand the actions of the monopolist in the conditions of antitrust restrictions and thus to improve the national antitrust legislation. The object of the research is an oligopoly as a basic unit in the market and its actions in the established conditions to profit the most. The novelty of the article lies in the fact that recently in the economic literature little attention has been paid to the study of oligopolies, especially in the conditions of antitrust restrictions.

Materials and Methods

The purpose of the study is to show how game theory can be used in the analysis of an oligopoly market subject to antitrust restrictions. This implies that the main methods used in the article are theoretical methods. First and foremost – analytical research methods, as a great number of different sources were analysed in the course of writing the article: from articles by foreign and domestic authors to various reports, documents, and other publications. Statistical or empirical data was used to a lesser extent due to the peculiarities of this work. In addition, the author applied the historical method to determine the formation of the oligopoly market in a historical retrospective. Analysis and synthesis were applied to process the theoretical framework of the study, in particular, to characterise the behaviour of monopoly companies in the market according to three types of state intervention: the first is administrative regulation, i.e. banning companies in certain activities, aimed mainly at reducing competition in the market; the second is price regulation, i.e. setting the boundaries in the market to form the price of products by monopolistic companies; the third is the establishment of the maximum market share that monopolists are allowed to occupy; forecasting to highlight the prospects for future development of the International Standards on Auditing. At last, generalisation was applied to summarise the work and the statistical method to process quantitative data.

The study used models that help to better describe the actions of monopolists in the market under antitrust restrictions. Mainly the Bertrand model is used in the study as the author concluded that the situation in which market players find themselves under antimonopoly restrictions in the market, in particular, limited the possibility to change output volumes, and the possibility to manipulate the market by means of price changes only, best fits the conditions set out in the Bertrand model. Other models (in particular, Cournot and Stackelberg) are also mentioned in the paper, but they do not describe so accurately the market situation under restrictions on monopolists as this model does.

The research on the chosen topic consisted of two parts. The first stage involved analysis of the specifics of

conducting anti-monopoly policy and how exactly it affects markets and monopolists from a theoretical point of view. The forming theoretical aspects of the subsequent part of the study, including a description of existing models for analysing oligopoly markets, description of game types, and the popular "prisoner's dilemma" and its interpretation in the oligopoly market were provided for in the first part as well. The second stage was devoted to describing the most successful strategies for monopolists in an oligopoly market whenever possible with a combination of the three main types of anti-monopoly policies. The state of new companies that entered the market due to the introduction of anti-monopoly restrictions in the market is also described in the second stage. Also, models of the monopolists behaviour in the oligopoly market are constructed and their profits and market shares as a function of their behaviour are described.

Results and Discussion

At its core, antimonopoly legislation is a complex branch of legislation that includes the norms of civil, administrative, criminal, and some other branches of law [9]. Its main task is to review cases of monopoly power in monopoly and oligopoly markets and, depending on the situation, apply certain measures to limit the powers of a company or several companies in the market. Most often, the committee's actions take the form of market price regulation, various kinds of administrative prohibitions or sanctions for a monopoly company regarding actions that could prevent competition in the market (e.g. buying other companies), etc. However, there is no single blueprint for a committee to regulate monopolised markets. Moreover, the rights and powers of anti-monopoly committees can vary greatly from country to country, so it is important to familiarise with them before analysing an oligopoly market.

In fact, there are several kinds of "games", each with its own characteristics: the normal format of games, which is divided into two: zero-sum games (in which the amount

a player loses is equal to the amount another player wins) and non-zero-sum games (in which the sum of both players' wins is not necessarily 0); extensive-form game (those in which players have many possible solutions, decision trees) are also divided into two kinds: perfect information (where players are aware of past choices) and imperfect information (players are not fully aware of past choices); characteristic form games where players can create alliances, coalitions, and partnerships [10]. In addition, the basic models of oligopoly markets in economics could be considered: the Cournot model where each company models its output and on the basis of this output the price therefore forms; the Bertrand model where companies produce a single demand in the market which is met by companies and there is only change in price and hence so-called "price war"; Hunt and Morgan theory which assumes that demand is not homogeneous and dynamic and also that consumers have imperfect information about products so that the aim of companies in the market is to achieve maximum productivity; the Stackelberg model due to which there is a leader company that determines output and product prices, when the company which is watching, can decide whether or not to accept an output imposed by the leader company. Stackelberg model can also be divided into two: a producer model in which the producer is the leader and determines the price in response to the retailers and competitors; and a retailer model in which the seller is the leader and the producer is his follower.

Another simple and fundamental model in game theory is the Prisoners' Dilemma [11]. It depicts a conflict of interest where each player influences the course of events and obtains information about the possible gains and losses from the game. However, in the course of this conflict, actions aimed to maximise self-interest leads to a worse outcome than that which could have been obtained from behaviour that wouldn't match the maximisation of given interests. In the original version, the dilemma is as follows (Table 1).

Table 1. Tabular interpretation of the prisoner's dilemma

Prisoner 2	Prisoner 1	
	Cooperation	Refusal
	Cooperation	5; 5
	Refusal	10; 0
		0; 10
		1; 1

Source: compiled by the author based on [12]

In the terms of this dilemma, both prisoners have 2 options: deny the crime or cooperate with the police and turn in their partner, who is sitting in a different cell. The prisoners have no opportunity to know about each other's actions. The numbers in the table indicate the number of years prisoners will have to stay in prison if they cooperate (with the police) or refuse to cooperate. In case of mutual refusal both will get 1 year, in case of mutual cooperation, they will get 5 years, in case of one of them refusing and the other cooperating the one who refused will get 10 years and the other one will not go to prison.

The most favourable course of action for both parties is to refuse to cooperate with the police, as they would then only receive 1 year of imprisonment each. However, there is a risk for each prisoner to receive 10 years imprisonment if the other prisoner cooperates. This becomes possible because in this case, the prisoner who cooperates gets the opportunity not to go to prison at all (gets the highest benefit for himself/herself) and also that they are guaranteed not to spend 10 years in prison. Thus, the rational behaviour (i.e. the behaviour that will lead to the best benefit and risk reduction) is to cooperate with the police, even though it may

not lead to the most beneficial outcome for both parties. This dilemma can be interpreted for an oligopoly market because in this market there is a possibility of collusion situation

between monopolists, or the creation of a cartel [13]. This interpretation is demonstrated in Table 2 below; the values written in the table are the revenues of the respective monopolists.

Table 2. Tabular interpretation of the prisoner's dilemma for the "players" (participants) in an oligopoly market

		Monopolist 1	
		Involvement in collusion	Betrayal
Monopolist 2	Involvement in collusion	100; 100	0; 150
	Betrayal	150; 0	50; 50

Source: author's devising

Table 2 shows that the most profitable option for both companies is to participate in the collusion, i.e. to create a cartel. However, there is a temptation for market players to break the agreement (betrayal), namely, to reduce the monopoly price presented during the collusion, which will lead to super profits for one of the companies (by increasing

demand for one company's products and decreasing the other's). In this case, the company that is still in collusion will be forced to reduce prices following the first, which will reduce both firms' profits (in Table 2 from level 100; 100 to level 50; 50). Figure 1 shows the same situation using a graphical model.

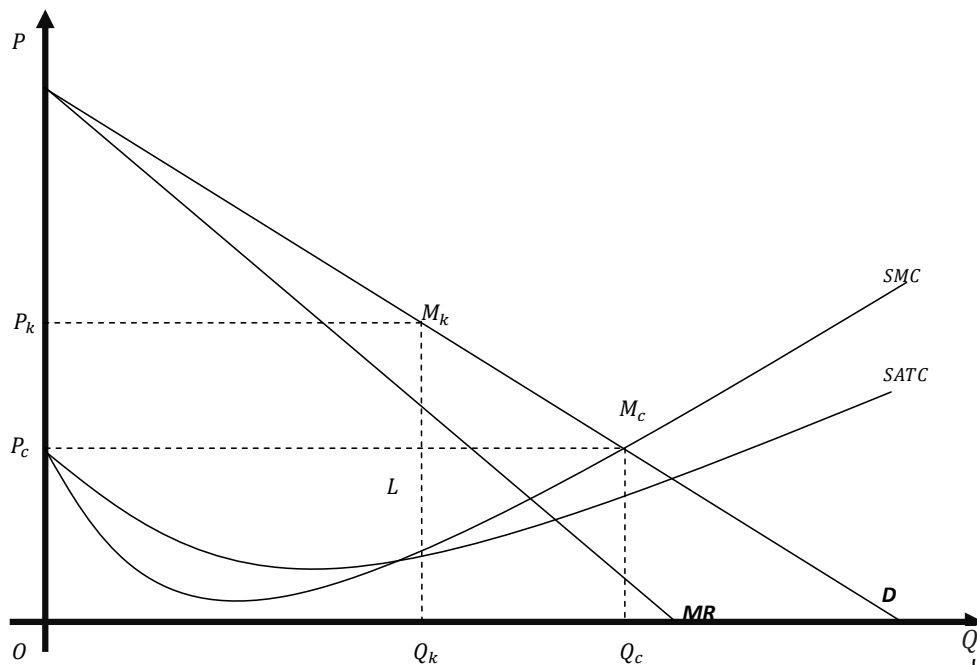


Figure 1. Graphical interpretation of the prisoner's dilemma

Source: author's devising

In Figure 1: P is price, Q is output, SMC is the short-run marginal cost curve, $SATC$ is the average short-run cost curve, D is the demand curve, MR is the marginal revenue curve, P_k, Q_k – price and demand when establishing a cartel, P_c, Q_c – price and demand when both companies compete. Thus, it is more profitable for both companies to output at a price P_k because the area of the Graph $P_k M_k Q_k O$ is larger than the area of the Graph $P_c M_c Q_c O$. However, at any time one of the market players may reduce the price to obtain additional profits from increased demand, which in time will reduce the price to the level of P_c and thus reduce the profits of each of the market participants by $S_{P_k O Q_k M_k} - S_{P_c O Q_c M_c}$ or $S_{P_k P_c L M_k} - S_{L Q_k Q_c M_c}$.

It is now appropriate to consider how monopolists would behave under antitrust restrictions. Since there may be several types of restrictions and they may be combined in various ways, several options for the behaviour of companies in the market should be considered. Let us review the first situation: in an oligopoly market (with a cartel), price limits were established with the maximum price in the market set below the price set by the cartel. In this case, the most likely outcome is that the price is set at the highest level allowed by the government. When fundamental differences between the companies' objectives as well as their intentions occur, it is possible to break the agreement and set the price at the level:

$$P = SMC = c \quad (1)$$

If companies have been prohibited from monopolistic activities, associated in particular with buying out companies, price and market share limits have been set, then new players may emerge in the market. Namely, if in an oligopoly market with undifferentiated products two companies with equal market shares were in a cartel with a set monopoly price at a level:

$$P_m = \frac{a + c}{2} \quad (2)$$

where a is the coefficient in the "price-sales" equation:

$$P(Q) = a - bQ \quad (3)$$

c is the marginal (and average) cost:

$$MC_i = AC_i = c \quad (4)$$

The government sets limits on the price in the market at a level:

$$[P_i; P^*], P_m > P_i, P_m > P^* \quad (5)$$

where, P_i – is the maximum price of a product in the market; P^* – is the equilibrium price in the market when new firms enter the market; equal to the SMC (short-run average cost) for small companies.

Due to the facilitation of entry into the market, related to the impossibility, from the legal point of view, for companies to apply certain actions that impede free competition, the number of companies n has the opportunity to enter the market by reducing the price of the product

from the level of P_m to the level of P^* . The only way out in this situation is for the companies to reduce the price as quickly as possible (in the Bertrand model, in which companies influence the market equilibrium primarily through price rather than "thrown goods" [14]) or to increase the quantity of output (in Cournot model, in which companies influence prices through a quantity of products placing on the market [15]) to a level P^* to avoid companies entering the market and taking market share. If, however, monopolists keep the price at the maximum level allowed by the government, this will create an incentive for new companies to enter the market, take over some of the market sales, and gradually reduce the price due to the increase in the number of products on the market. In fact, monopolists may make new cartel agreements with these companies as well, keeping the price high, but over time there will be so many that it will become impossible to maintain the cartel, leading to a price reduction towards the equilibrium level P^* . Once the price reaches this level and the small companies have gained a large market share, it will be impossible for monopolists to raise prices to achieve monopolistic profits because of the broken demand curve in a monopoly market, that is, the rigidity of prices. At this point it is impossible for companies to raise prices independently in an oligopoly market without suffering losses; this also indicates asymmetries in rival responses to price changes: if one market player raises prices, others are not likely to follow, as the current level brings more profit if there is a high demand for the product. The model of this curve in an oligopoly market is as follows (Fig. 2).

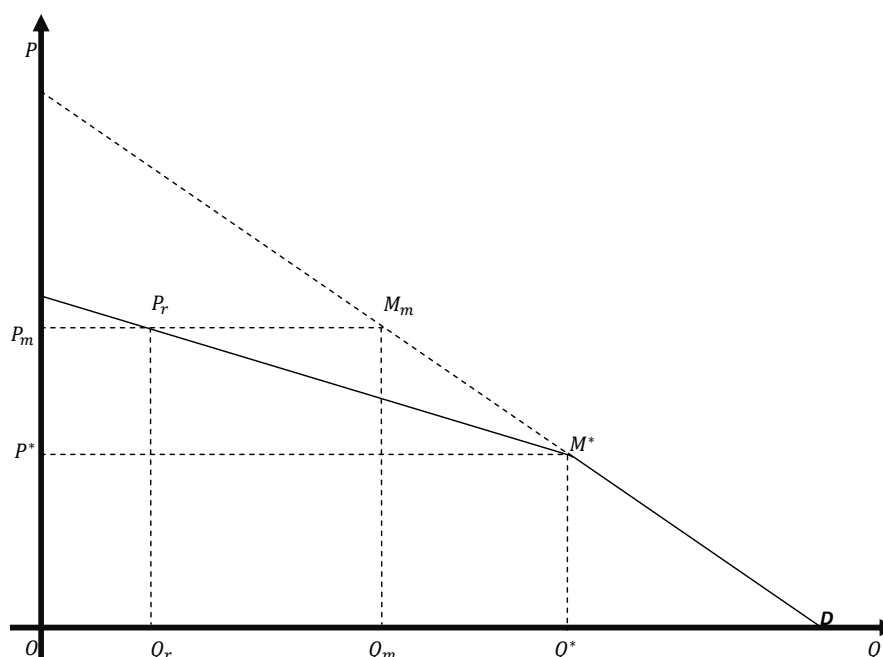


Figure 2. Model of a broken demand curve in an oligopoly market

Source: author's devising

Figure 2 demonstrates that at the point where the market is now (M^*), there is a break in the demand curve which is caused, as mentioned above, by an asymmetry in the activity of market players. Thus, if one of the market players sets a monopoly price P_m he or she will not be able to produce quantities of Q_m , but only to the extent of Q_r . As the result, the monopolist's income is $S_{P_m P_r Q_r O}$ instead of $S_{P_m M_m Q_m O}$ and is lower as well. Thus, once the price has been reduced in an oligopoly market and many other companies have been allowed to enter it, it is not possible to return to the previous price level, nor is it possible to create a cartel in that market. The most appropriate strategy is for both companies to reduce the price level to P^* . However, this should be done while in the cartel, because if these conditions are violated and if the government permits in the future, the price may fall below the marginal short-run costs of small companies in the market due to continued competition between the companies, resulting in zero profit for the monopolists. The existence of profits even when the price P^* is reached in the market is due to economies of scale, which are manifested in large output volumes of the company and, consequently, its lower long-run (and short-run) average costs [17].

In addition, when anti-monopoly restrictions are imposed on a market, there may be a measure to limit the market share for companies with a monopoly position. In such a case, market players will not be able to defend their market shares and will lose share anyway. Suppose, before antitrust restrictions were imposed, the market was divided in half between market players and there was an agreement between them to set a monopoly price of P_m . After the introduction of restrictions, the maximum possible market share of the companies is:

$$x_i = \frac{q_i}{Q} \text{ or } \frac{q_i}{Q} \times 100\% \quad (6)$$

Therefore, the maximum share for each of the monopoly companies equals x_m (the share is maximum) and the output of their products is equal:

$$q_m = x_m \times Q \quad (7)$$

Other companies entering the market due to restrictions have a minimum market share x_c :

$$x_c = 1 - 2x_m (\times 100\%) \text{ or } \frac{Q - 2q_m}{Q} (\times 100\%) \quad (8)$$

The market share of each of the n new companies is equal:

$$x_i = \frac{x_c}{n} \quad (9)$$

In this situation, the market has all the same restrictions: the price can only range from P_i to P^* ; in addition, monopolists are forbidden to conduct any activity which could prevent healthy competition, including buying out companies or reducing the price too much so that the company leaves the industry (this is why the lower bound price is limited to P^*). Since monopolists cannot use products quantity as a mean of influencing the market (due to the existence of smaller companies that want a larger market share from the monopolist, as well as restrictions in the maximum market share), the price remains the only sure way to influence the market, which makes this model closer to Bertrand's one [18].

In the Bertrand model, the largest possible income π generated by industry is equal to:

$$\pi = \frac{(a - c)^2}{4b} \quad (10)$$

This can be deduced by multiplying the monopoly price in the market (P_m ; formula 2) and the monopoly volume, which then equals:

$$P = a - bQ; \frac{a + c}{2} = a - bQ_m; Q_m = \frac{a - c}{2b} \quad (11)$$

Due to Bertrand, in order to obtain additional profits, one of the monopoly companies will reduce the price by an amount ξ to the minimum level at which the price equals the costs, i.e. the equilibrium condition in a perfectly competitive market will be fulfilled. If antitrust restrictions are introduced, the role of a market player that lowers the price will be played rather by small companies entering the market than one of the monopolists. In this case, although not immediately, but after some time, in particular after the monopoly companies reach the maximum level of production allowed to them in the market of x_m they will have to reduce their price to the level of P^* . An increase in price after reaching given price level would not make sense either, due to the broken demand curve that has been precisely reviewed in Figure 2. This market situation is depicted in Figure 3 below.

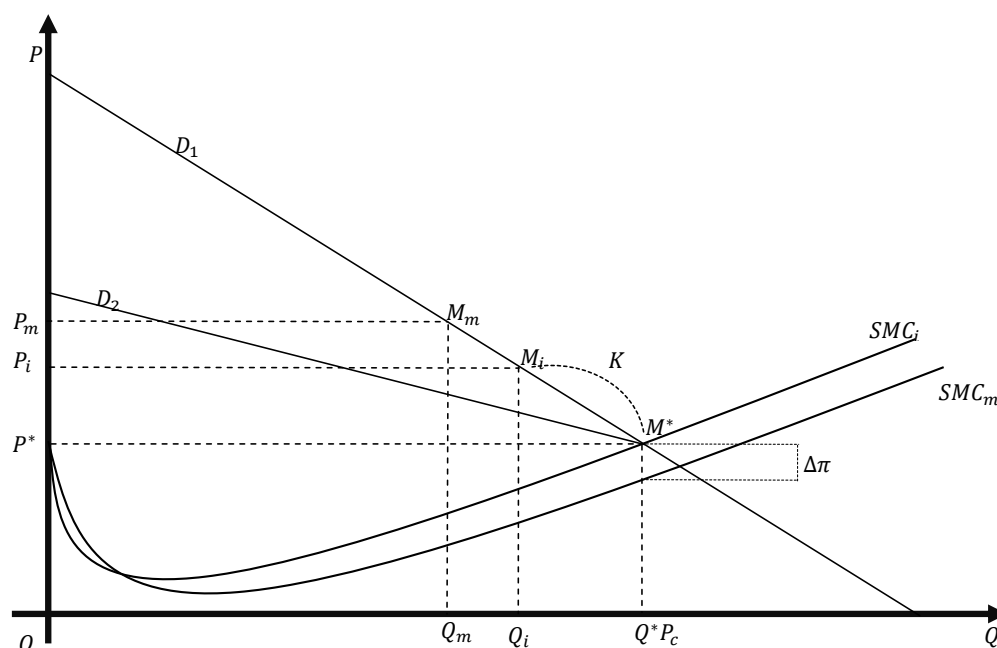


Figure 3. Monopoly market situation in regulating price, monopoly market volume, and the presence of administrative prohibitions on monopolies

Source: author's devising

In the Figure 3: D_1 and D_2 – are, respectively, the demand areas and the broken demand curve (i.e. the demand curve for a monopolist who wants to raise the price); K is the price range at which new companies will enter the market; $SMC_i = c_i$ – marginal costs of new (small) companies in the market $SMC_m = c_m$ – marginal costs of monopolists; $\Delta\pi$ – is the difference in profits of new companies in the market and monopolists.

Figure 3 shows that once the new maximum price is set at P_i new companies will enter the market until the number of monopoly companies decreases to x_m . After that, the monopolists have to reduce the price to the market level and the price will fall to the level of P^* where the price equals the short-run (and long run) costs of small companies on the market (SMC_i). At the same time, due mainly to economies of scale, companies will make a profit of $\Delta\pi$ or π^* . Therefore, small companies in such a market will make zero economic

profit in the long run and monopolists will make a small profit equal to:

$$\pi^* = SMC_i - SMC_m \quad (12)$$

Nevertheless, their profits will be considerably lower than they would have gotten at the price levels of P_m and P_i . Each of the small companies will have a market share of $\frac{100-2x_m}{n}$ and will produce output equal to $\frac{Q(100-2x_m)}{n}$ or q_n . The monopolists, on the other hand, will get market shares of x_m and market volume Qx_m or q_m . In general, the set of small companies in a given market can be seen as one large monopoly company, unwilling to enter into a cartel with other monopolists, and constantly in a struggle for supremacy, but with higher costs.

Table 3 was created in order to summarise the actions of monopolists in an oligopoly market in the case of antitrust policy, with the main conclusions.

Table 3. Most profitable company policies under different types of anti-monopoly policies in the market

Anti-monopoly policy	The most favourable company policies	Monopolist profits	Monopolist market share	Profits of new companies in the market	New company's market share
Introduction of administrative prohibitions	Price reduction to P^* level	$P^* - c_m$	50%	0	0
Setting price limits	Selling at the highest possible price and preventing other companies from entering the market (mainly by buying them out)	$P_i - c_m$	50%	0	0

Table 3, Continued

Anti-monopoly policy	The most favourable company policies	Monopolist profits	Monopolist market share	Profits of new companies in the market	New company's market share
Establishing market share	Selling at a monopoly price until the market share limit is reached and then selling at P^* level; conducting activities that prevent other companies from developing significantly in the future	$\frac{(a-c)}{2}$ at the start and thereafter		c_i at the start and 0 thereafter	_____
Introduction of administrative prohibitions + setting price limits	Price reduction to P^* level			0	0
Establishing a marginal market share + setting price limits	Selling at the highest possible price until the market share limit is reached and then selling at P^* level; operating at a level that prevents other companies from developing significantly in the future	at the start and		$P_i - c_i$ and 0 thereafter	_____
Introduction of administrative prohibitions + establishing a marginal market share	Selling at the monopoly price until the market share limit is reached, and then selling at the P^* level	$\frac{(a-c)}{2}$ at the start and thereafter		at the start and 0 thereafter	_____
Introduction of administrative prohibitions + setting price limits + establishing a marginal market share	Selling at the highest possible price until the market share limit is reached, and then selling at P^*	at the start and		and 0 thereafter	_____

Source: author's devising

As Table 3 demonstrates, different types of anti-monopoly policies will benefit monopolists in different ways. Nevertheless, in any case, it is more advantageous to participate in a cartel, as creating a "price war" between monopolists, i.e. a market condition where each company tries to maximise profits by reducing the price by ξ unit (most often by 5%) [19], per Bertrand, results in zero profits for monopolists in the long run [20].

Conclusions

The study examined the main types of anti-monopoly policy in states. Among them, price policy, restriction of market shares, and administrative prohibitions were highlighted. However, anti-monopoly law differs from country to country, and the legislation itself does not prescribe the exact numbers and steps of policy action, given the individual nature of markets and situations. Therefore, in practice, every monopolist's (as well as anti-trust committee) decision in a market will be individual and special. However, the paper, with some assumptions, formed the basic, theoretically grounded, actions of monopolists in the context of antitrust policy.

The main achievement of the study is the proof that due to the existence of economies of scale, it is profitable for monopolists to cooperate with each other in a cartel even

after anti-trust restrictions are imposed on the basis that ending cooperation leads to zero profits for large market players, i.e. is unprofitable for them. The only exception to this rule is when all three types of antitrust restrictions are imposed, because of which it is impossible to reduce the price below the level effective for small companies P^* as it would make them fail to get positive profits so they leave the market. Since this is unacceptable to the government, it will not allow this to happen and will increase prices on its own. Thus, another important objective of the state in creating and conducting an anti-trust policy is to monitor monopolists to prevent them from creating cartels. In addition, the paper found that new companies entering oligopoly markets after anti-trust restrictions were mostly profitable in the long run or only in the initial stages of market formation. Their development in a given market, even after the introduction of some types of antitrust restrictions, is difficult or impossible because of the conditions investigated and the unmistakable policies of monopolists.

Therefore, an anti-trust policy is an effective method of creating a more competitive market and increasing public welfare, although it does not deprive monopolists of all the benefits of the market, in particular, additional revenue at the expense of the size of these companies.

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Використання теорії ігор у конкурентному середовищі для побудови стратегії взаємовигоди (з урахуванням антимонопольних обмежень)

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Анотація. Сучасний економічний простір характеризується актуалізацією такої ринкової структури, як олігополія, у зв'язку з чим виникає потреба в її належному теоретичному та емпіричному дослідженні. Мета роботи полягає у проведенні аналізу використання теорії ігор на ринку олігополії за вказаних умов. Основними науковими методами, використаними під час написання роботи, стали теоретичні методи, зокрема аналіз, синтез, історичний та статистичний методи. Визначено, що теорія ігор одна із найважливіших відносно нових математичних теорій, що застосовуються в процесі розробки різних видів економічних моделей, зокрема аналізу ринків і формування стратегій діяльності підприємств. Підтверджено, що найчастіше теорію ігор застосовують до аналізу ринку олігополії, тобто такого ринку, на якому ведуть діяльність від двох до декількох великих гравців та рішення кожного з яких впливають як на ринок загалом, так і на доходи та становище інших «гравців» ринку шляхом впливу на ціну виготовленої продукції чи обсяги її випуску (залежно від моделі). Вказано, що існує безліч способів застосувати теорію ігор як основну, і спробувати пояснити стан, в якому перебуватиме ринок, доходи, втрати та частка виробників на ринку олігополії через різні умови та змінні. У цій роботі розглянуто використання теорії ігор з урахуванням антимонопольних обмежень та при отриманні компаніями олігополістами взаємної вигоди. Обґрунтовано, що найчастіше в моделях, створюваних економістами, взаємна вигода компаній на ринку олігополії передбачає існування домовленості між учасниками ринку, за якої компанії отримують більшу вигоду, ніж за умови конкуренції між ними (картеля). Практична цінність статті полягає у теоретичному обґрунтуванні теорії ігор на ринках загалом, у наданні певних практичних стратегій діяльності компаній на ринках, що стане корисним і для студентів у процесі навчання, і для інших вчених економічних дисциплін

Ключові слова: олігополія, теорія ігор, аналіз ринків, антимонопольна політика, картель

Urban Parks as an Innovative Social Space and a Factor of Social and Environmental Welfare

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Abstract. The relevance of the study is supported by the fact that the key requirements for modern urban parks are their compliance with the needs of public space, along with their high importance in performing environmental functions. Public and environmental criteria for the construction of parks often contradict one another. Therefore, the purpose of the article is to present a clear integrated approach to solving the problem of developing urban parks in Ukraine and provide proposals for their additional financial and institutional support. The main direction of the methodology of scientific research was the system approach, namely its aspects: system-element, system-functional, system-resource and system-communication. The study revealed the importance of promoting parks as public space, and determined their recreational value for residents of modern metropolitan areas, especially during the COVID-19 pandemic. The importance of programmatic support for ecosystem services groups of parks that will contribute to their effective operation in terms of social and ecological significance is substantiated. It is proposed to introduce tax incentives and non-market forms of support for enterprises, institutions and organizations that would encourage them to participate in the improvement of parks as one of the ways to solve the lack of funding for parks and stimulate their development. It is indicated that the amount of tax benefits depends on the activity of entrepreneurs in improving parks and creating new green areas, and act on a voluntary basis. The practical value of the work lies in the fact that the recommendations can be used by the authorities in the process of developing programs for the maintenance, financing and operation of parks, in order to increase their environmental and social effectiveness in the welfare of cities

Keywords: ecosystem services, parks, social direction, financing, institutional regulation

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Introduction

Today, the recreational functions of the park environment for large cities are one of the key factors in the physical and mental rehabilitation of urban residents, and at the same time encourage contacts of various social groups and interests. The main statistics that cover the social and recreational opportunities of parks for residents of modern megacities can be found in the reports of the National Recreation and Parks Association (NRPA) in the United States [1]. In Ukraine, at one time, a detailed analysis (mainly technological support) of urban parks was carried out by such scientists as: V.I. Bilous [2], Yu.Yu. Nelgovskiy [3], A.D. Zhyrnova [4], and many others. At the same time, it is advisable to mention a number of modern scientists engaged in the study of parks, namely: the sociological significance of the common practice of walks for city residents [5], assessment of the cultural and historical value of parks [6], the role of park complexes in the urban ecosystem of the city [7] and others.

In modern conditions of a market economy, the support and organization of parks should also be considered from the point of view of economic teachings. At the same time, according to socio-cultural prerequisites, the prospects for implementing scientific achievements in improving the system of maintenance and improvement of parks largely depend on the economic interest of potential investors and the competent organization of economic support. Increasing the density of the urban population requires a qualified analysis of promising areas of the park environment in accordance with current trends in nature management. Therefore, it is reasonable also to consider the promising developments of Ukrainian scientists in the field of economics of nature management, namely: M.M. Petrushenko [8], G.M. Shevchenko and others [9; 10].

From the NRPA statistics, it becomes clear that in modern cities, parks are not only an ecological, but also a social infrastructure [1]. As of 2021, 58% of parks and recreation in the United States are provided with programs for young people. For its part, the development of socially oriented programs for park management contributes to an increase in financial turnover in this field. For example, park operating expenses are \$88.30 per capita per year, and the income from operating expenses is 22.9% [1]. In the NRPA report *"The Economic Impact of Park"* [11] as of 2017, it was established that capital expenditures by city parks and recreation agencies brought \$166 billion into the U.S. budget and supported 1.1 million jobs. Another report indicates that as for 2019, the share of GDP profit from outdoor recreation was \$459.8 billion (2.1% of total U.S. production value) [11; 12]. For this reason, we believe that the successful development and preservation of parks should take place in a combination of different interest groups and areas of urban space development, namely: public interests and public health, environmental welfare, interests of local legal entities and financial welfare of park maintenance and development organizations. Such cooperation, firstly, will provide significant advantages in various

areas of public welfare, and, secondly, will become a certain guarantee of protecting parks from illegal interference and destruction.

The purpose of the scientific article is to design and propose an integrated approach to the development of parks as a public space, along with the preservation and enhancement of their environmental functions, as well as the development of economic incentives for extra-budgetary financing of parks and their support.

Materials and Methods

In the scientific article, it is necessary to build a comprehensive vision of the issue of organizational and economic support of parks, and their functioning from the point of view of social and environmental benefits for the welfare of urban residents. Therefore, the main direction of the methodology of the chosen research was the system approach, which is applied in such aspects of studying the issue: system-element, system-functional, system-resource and system-communication.

At the first stage, using all these approaches, a two-dimensional conceptual model for the development of organizational and economic support for urban parks was constructed. This model represents the author's vision of combining the directions of innovation implementation and components of organizational and economic support.

One of the priority areas of innovative solutions in improving parks is social and ecological welfare. Therefore, the second step was to analyze statistical data from NRPA (USA) [13] sociological studies regarding the importance of parks during a pandemic and to determine the main trends in this field. It is established that the richness of ecosystem services of parks in the United States allows them to be used as a full-fledged recreational space. There are no such studies in Ukraine, so the author conducted a survey of Ukrainian residents regarding their preferences in the field of park development. The survey was conducted during the first half of 2021 on the basis of Google Forms. The questionnaire was distributed via Facebook to the pages of universities, public and environmental organizations, and eco-activists. Everyone could take part in the survey since the questionnaire is designed for an ordinary park visitor. Regarding geographical boundaries, respondents were from all parts of Ukraine, but most the results were received from the cities: Selidove and Ukrainsk (Donetsk region), Kyiv, Lviv and Odesa. It should be noted that during the survey period (February – May 2021), only 320 responses were collected. There were few applicants, which can be explained by the lack of such survey practices in the field of park improvement in Ukraine, with the subsequent introduction of innovative solutions based on the needs of citizens. In total, the questionnaire contains 13 questions that relate to the satisfaction of citizens with their local parks, wishes for their improvement and actual development. As a result of the second stage of research, a number of problems that need to be solved for improving urban parks in Ukraine were identified.

The third step briefly substantiates a solution to one of the highlighted problems of park organization and maintenance, namely supporting their ecosystem services. The main material on this topic is presented in detail in the author's article [14]. At the fourth stage, based on the foreign experience of program support for parks in the United States and London, it is proposed to introduce program support for parks in Ukraine. It is also proposed to link the development of programs to groups of ecosystem services, which will increase the efficiency of parks in their social and environmental significance.

All these proposals for improving parks require additional funding, so the fifth stage is devoted to the development of economic incentives for extra-budgetary financing of parks. One of the promising areas of financial search is the assignment of funds to enterprises and organizations on a voluntary basis, which will have tax benefits and discounts in advertising activities as a bonus.

Based on the analytical work in the scientific article, and partly based on the results of the author's already published articles, recommendations are made for an integrated approach to improving parks and promoting population welfare.

Results and Discussion

Comprehensive vision of the problem of improving the organizational and economic support of urban parks as objects of public and environmental welfare

To understand the main components of the question of park development, the selected issue can be presented in the form of a two-dimensional conceptual model. On the Ox axis, we present the main directions of innovation implementation, and on the Oy axis – organizational and economic support, combinations of which provide a complete picture of the necessary improvements and innovations (Fig. 1)

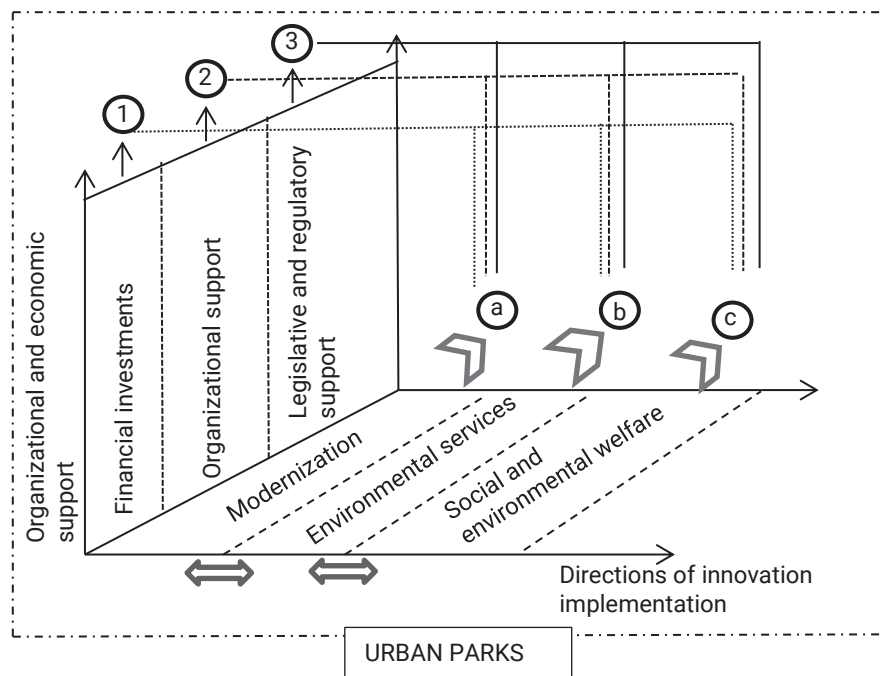


Figure 1. Two-dimensional conceptual model for the development of organizational and economic support for urban parks

Source: compiled by the author

As can be seen from Figure 1, in the two-dimensional conceptual model of urban park development, the following combinations of organizational and economic support and directions for implementing innovative solutions can be represented, namely:

- 1a – financial support for the modernization of the park management and maintenance system;
- 1b – financial support aimed at preserving and developing ecosystem services in parks;
- 1c – financial support for parks in order to increase social and environmental welfare;
- 2a – organizational support for the development of a new system of improvement and management of urban parks;

- 2b – organizational support of urban parks ecosystem services;
- 2c – organizational support in the parks of cultural activities of a social nature – socialization, education and recreation;
- 3a – legislative support for improving the system of institutional provision of urban parks;
- 3b – legislative and regulatory support for groups of ecosystem services of urban parks, legislative support for provisions on their protection and development;
- 3c – legislative support and development of activity programs of urban parks in order to improve the social and environmental welfare of the population.

The direction of improving ecosystem services should be a priority, around which the modernization of parks and the development of the social sphere for their use are based. Foreign practices show that an important tool for interaction with the public to improve parks is opinion polls, which guide strategies for the development of urban

parks in a direction that is relevant to society [13]. One of the most important areas of development of parks is their recreational opportunities. This is confirmed by the results of the survey *"Take a Vacation at Your Local Parks"*, NRPA, which showed the importance of parks as a recreational space during the COVID-19 pandemic [13] (Fig. 2).

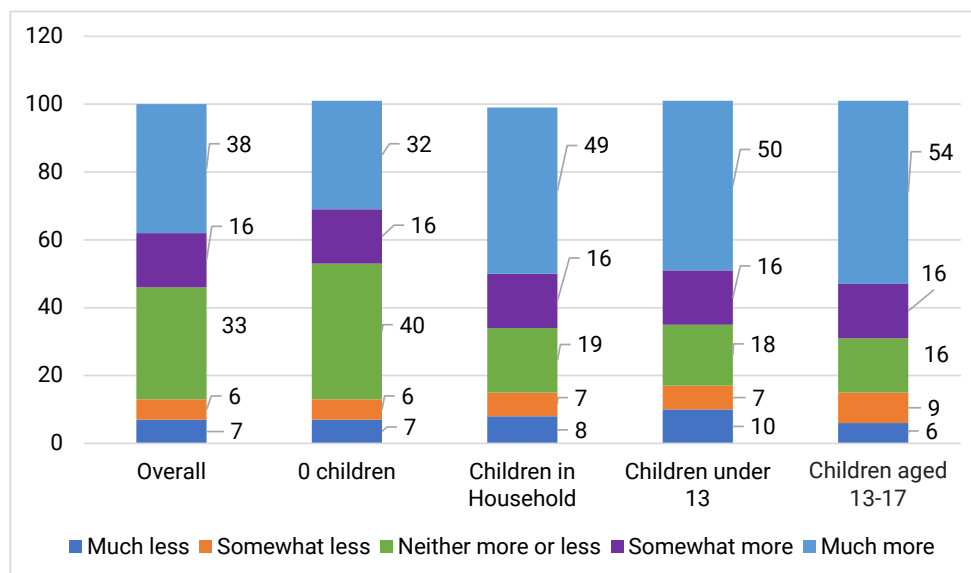


Figure 2. U.S. residents' preferences for recreation in parks in conditions of the global COVID-19 pandemic (based on the criterion of children in household)

Source: [13]

Therefore, the survey respondents *"Take a Vacation at Your Local Parks"*, the results of which are presented in Figure 2, were asked: "How much more or less likely are you to choose a vacation spot closer to home this summer, given current conditions? (due to COVID-19 pandemic). The overall result can be described as follows:

- approximately 54% of American adults will choose a local park for their summer vacation;
- parents are more likely to choose a park near their place of residence for summer vacation than people without children (66% vs. 48%).

According to the above, local parks in the United States have great opportunities for family recreation, and can provide recreational services during a pandemic within the residence of citizens. In other words, a city park can become a place for recreation, and even replace long-term trips for recreation purposes. This fact suggests a promising development of recreational complexes within the city, which can be associated with the ecosystem services of parks. It is important to note that US parks have programmatic support for their activities, which takes into account the interests of all categories of the population [15], which, however, is not available in Ukraine. At the same time, empirical research on the ecosystem services of urban parks can also be found in works of X. Cheng, S. Van Damme, P. Uyttenhove [16], L. Pinto, C.S.S. Ferreira, P. Pereira [17], J. Kim, Y. Son [18], and M.L. Talal, M.V. Santelmann, J.H. Tilt [19].

In order to determine the basic requirements for parks in Ukrainian cities, in 2021 the author conducted a survey of residents of different cities regarding their preferences in the organization of parks, current areas of development and significant problems in terms of visitors. The largest number of respondents' answers was received from the following cities of Ukraine:

- major cities are Kyiv (38), Odesa (29);
- large cities – Lviv (26);
- small towns – Selidove (72) and Ukrainsk (45) in Donetsk region.

From the analysis of responses for these cities the following generalized results were obtained:

- the responses from all cities have a common feature – respondents attach great importance to the natural component as a key factor in favorable impressions, and at the same time note the quality of infrastructure (approximately 95%);
- for major and large cities, such as Kyiv, Odesa and Lviv, the most desirable are recreation parks and beautiful landscapes (54-80% of respondents), and parks of biological diversity (Kyiv and Lviv). Only 3% of Kyiv residents voted for amusement parks, and in Odesa and Lviv they did not get a single vote, which is quite significant. In large cities, entertainment venues are quite developed, so parks that provide an opportunity to retreat to nature and a break from the pressures of urbanization;
- for small towns (Selidove and Ukrainsk), recreation parks and beautiful landscapes are relevant (43 and 24%,

respectively), and amusement parks for children and adults (30-44%). According to the results of open responses, in these cities, in addition to the need for outdoor recreation, there are still unmet needs for active public recreation in the form of entertainment, recreational and sports activities;

- for major and large cities (Kyiv, Odesa, Lviv), the main factors contributing to the decline in park attendance are the lack of free time and the lack of parks in the area of residence. This leads to the conclusion that it is necessary to improve the general plans of cities in terms of landscaping. For urban business centers it is appropriate to create parks for lunch breaks for the working population, the possibility of temporary arrangement of parks for business meetings, conferences, negotiations, seminars. For residential areas, it is relevant to create parks within a 10-minute walk, this practice is already popular in the United States [20];

- for the small towns of Ukrainka and Selidovo, the main factors reducing the attendance of parks is mainly the lack of maintenance of the territory and the lack of infrastructure. This once again indicates that the parks of small towns have an extremely low level of improvement to meet the needs of visitors for a favorable experience and recreation.

It will be important to present the results of answers to open-ended questions, which give respondents the opportunity to express personal opinions that are important from the point of view of park users in each of the cities. In open answers, it is possible to identify the problems of parks and current needs for their development according to citizens. Thus, the residents of Lviv are more attracted to natural parks with a developed natural component, the infrastructure is seen only as maintaining the comfort. From the analysis of the open-ended questions, it is possible to select the ideas of respondents that would be extremely relevant for the improvement of parks in Lviv: forming mixborders that would create aesthetic natural locations; improving citizen safety in parks; creating separate lawns for recreation; landscaping parks close to the natural style that promotes rest and tranquility; combining parks into a green network with bicycle paths and walking trails; creating interdistrict greenways that would encourage pedestrians to take walks.

As for the city of Kyiv, despite its recognition as a green capital, the respondents' answers revealed a number of problems that need to be solved: increasing the accessibility of parks within the residence, ensuring security in parks – the presence of police patrols and video cameras, allocating protected areas in parks to preserve biodiversity, solving the problem of lack of funding, developing requirements for the culture of visiting parks, providing parks to the city's microdistricts regardless of the presence of squares, solving issues of illegal development of parks, compliance with the rules for planting trees and flowers. For Odesa, according to the respondents, the relevant measures for the preservation and support of parks will be the following: increasing the number of parks, improving the quality of cleaning and maintenance, the introduction of social advertising for the preservation of parks, designing new neighborhoods with a mandatory park area, a ban on the legislative level reducing existing parks, the availability

of parks in places of residence, improving the culture of leisure in the parks. For the cities of Selidove and Ukrainsk, similar problems can be selected, namely: a small number of parks and public recreation spaces, insufficient infrastructure equipment and low level of maintenance of territories, the need for zoning parks in order to ensure the interests of all categories of visitors, dissatisfaction with the needs of the population both in a quiet holiday and in cultural public events, addressing the problem of vandalism in parks, public involvement in park problems, restoration of existing park infrastructure – attractions, summer theaters, fountains, lighting, etc., better care of greenery.

Comparing the organizational and economic support and functions of urban parks in the United States and Ukraine, it can be noted that most of the recreational potential of Ukrainian parks is not used. Based on the analysis of the above-mentioned survey results in the United States and Ukraine, it can be assumed that the effectiveness of the functioning of park facilities and the opening of new horizons in this area depends on the solution of a number of problems: support for park ecosystems, because they create recreational and cultural opportunities; the availability of appropriate program support for urban parks in their activities; increasing the rating of parks in the lives of citizens; attracting additional funds and interested parties; creating new parks that satisfy all categories of citizens.

Maintaining the functioning of parks and improving their rating for citizens

As can be seen, one of the significant factors of quality improvement, according to respondents, is the maintenance of the natural environment. Due to the multi-functional nature of urban park ecosystems, the approach to their institutional regulation and support should be multi-faceted, and aimed at improving the manifestation of their qualities. In science, there are four generally accepted groups of ecosystem services [21]: providing, regulating, cultural and supporting. Providing services have a purely utilitarian meaning, and they are not typical for urban parks. There are still three groups of ecosystem services that require an individual approach from institutional regulation:

- regulatory services – support through administrative regulation of plant protection, sanitation control and geoecological safety;
- cultural ecosystem services – administrative regulation of cultural development and social direction;
- supporting ecosystem services – administrative regulation to protect biocenoses, improve plant function, and regulate wildlife.

Details of administrative support for each of the ecosystem service groups are described in the author's article [14]. We believe that the institutional and organizational support of ecosystem service groups in parks will allow regulating negative natural and anthropogenic environmental factors and social needs and issues by strengthening and regulating certain ecosystem groups. Rich opportunities to offer ecosystem services to parks are a prerequisite for the implementation of various programs of recreation, rehabilitation and social activities.

It should be noted that the social approach to organizing parks is very developed in Europe and the United States. In Ukraine, such experience is almost nonexistent. The author analyzed the implemented landscaping programs of such cities as New York [15] and London [22], and drew the following conclusions about the functioning of parks: significant development of recreational and health functions; availability of educational opportunities

in parks; adaptation and support for vulnerable segments of the population; the presence of a volunteer movement and active participation of citizens in landscaping.

Based on the analysis, recommendations are made to improve the environmental and social efficiency of parks functioning through the implementation of programs for their development (Fig. 3):

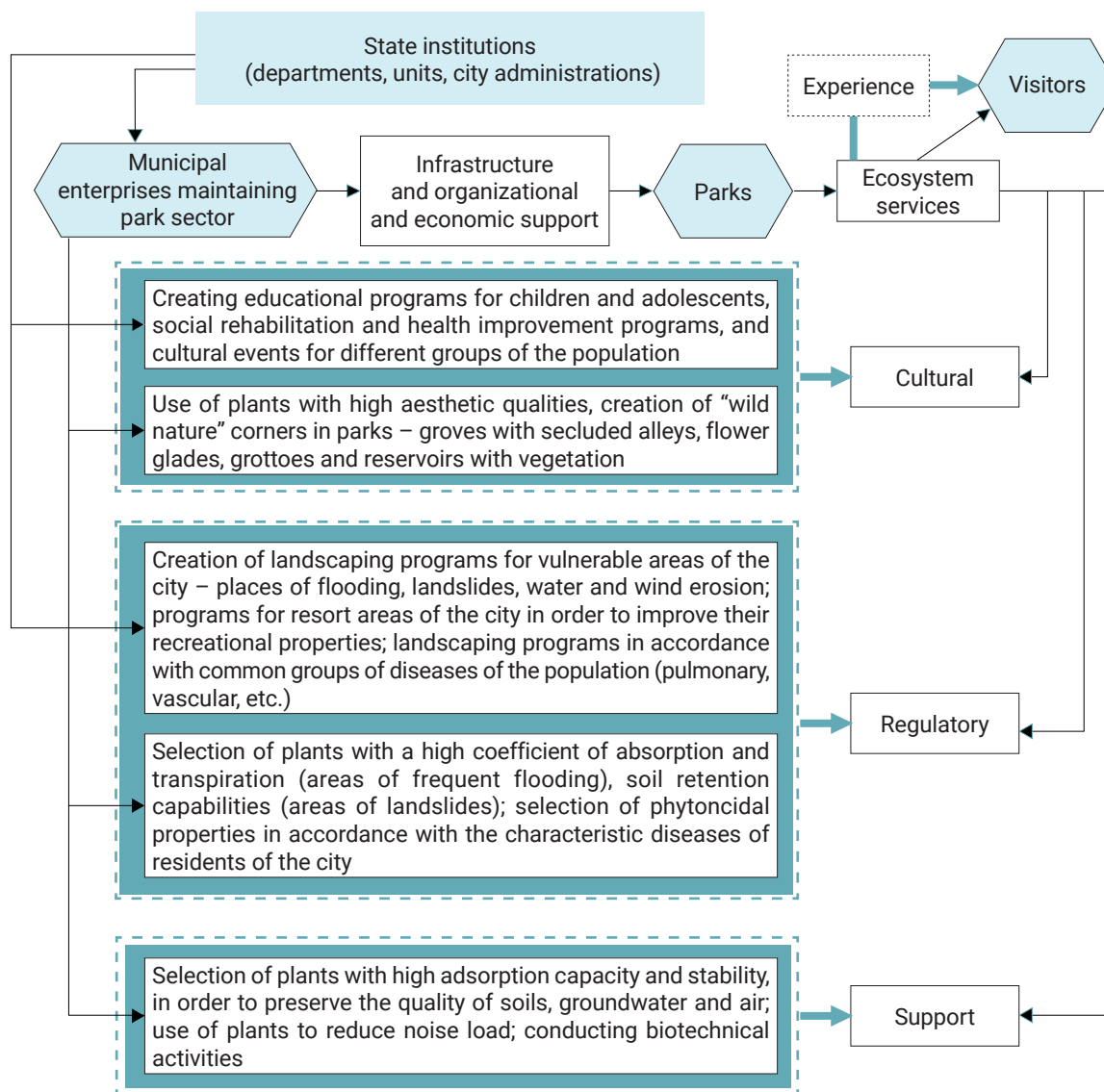


Figure 3. Formalized scheme of the interconnection of institutions that support park operations

Source: compiled by the author

As can be seen from Figure 3, park functioning programs can have a rich social, recreational and environmental range of services. Urban park ecosystems provide a wide range of cultural services. Thus, the experience of parks in New York [15] shows the possibilities of using parks as part of educational programs. Popular programs for schoolchildren include natural history lessons in the parks; environmental and local history programs adapted for children and teenagers; survival lessons in the natural environment, and camping. All programs are conducted by specialists and are delivered in the most interesting form

with live examples. Another popular area is rehabilitation programs, according to which fitness and dance classes of all levels of difficulty are held in the open spaces of the park. Sports sections for children, in particular from vulnerable segments of the population, are very common. These programs evenly cover all parks of the city for the convenience of citizens and are held under the supervision of specialists. Special emphasis should be placed on the joint cooperation of parks with recreation centers, which provide the opportunity for sports and swimming indoors for the cold season. In addition, parks in cities are an important

place of social life, and the following events are held on their territory: events for the elderly, outdoor cinemas, bird-watching with specialists, excursions in parks that include interesting information on history and environment [15]. For Ukraine, the development of cultural ecosystem services of parks is also relevant, which requires not only the introduction of appropriate programs, but also the creation of new areas of parks.

In order to strengthen the “regulatory” ecosystem services of parks and their ecological functions, it is planned to design them in vulnerable areas with an appropriate selection of plants (for places of flooding, wind erosion, landslides). An example of park projects for vulnerable areas are swamp parks [23], which, in addition to solving the problem, are becoming a popular place for visitors. The properties of plants can also be used to improve the organoleptic parameters of urban space and counteract common diseases of the urban population. For the resort areas of the city are appropriate plantings that enhance the recreational qualities of parks, in particular, it can be lavender meadows, juniper and pine groves, the creation of clover plantations. An example of using plant space for treatment is such existing projects as: “Nacadia” in Denmark, “Healthy Parks Healthy People” (Australia), “Recreational Forests” (Korea) [24].

In order to improve the “supporting” ecosystem services of the parks, it is relevant to carry out biotechnical activities involving organizational work in order to ensure the conditions and support the life of wildlife in the parks. Such measures include [25]:

- creation of plantings of bushes for nesting and sheltering birds, fruit and berry bushes and ground cover plants to provide them with food;
- creation of artificial nesting sites and shelters for birds, squirrel nests;
- creation of water bodies that are the center of biodiversity in the urban ecosystem;
- humane methods of dealing with stray animals (especially dogs), which can pose a danger to both small animals and humans, and often become a stressful factor for timid vacationers;
- creating information boards for visitors on the rules of feeding squirrels and various bird species;
- creation of decorative and flower stands in order to maintain the population of wild bees, because, as studies have shown [26], approximately 100 populations of wild bees have been identified in the parks of Kyiv, 80% of which are terrestrial, and three species are listed in the Red Book of Ukraine.

Methods of additional financing and involvement of stakeholders for the proper functioning of urban parks

The implementation of all the above-mentioned programs and improvement of landscaping requires additional funding. Today, all city parks are subsidized from the city budget. In the recommendations of the World Health Organization on the maintenance of green spaces, partnerships with local enterprises and organizations are considered a significant factor in financial support for green areas. Given this fact,

it is possible to offer to attract funds from legal entities, for example, by entering into agreements of public-private partnerships in the field of urban park improvement. In order to attract potential investors to finance parks, appropriate incentives are provided for the development of public-private partnerships. This aspect is considered in more detail by the author in the article [27]. Among them, the following can be distinguished: tax incentives, insurance protection, market assistance, promotion of investment activities in parks.

In the scientific article, it is advisable to take a closer look at tax incentives and non-market forms of support for enterprises, institutions and organizations that would encourage them to participate in the improvement of parks. One of the most significant stimulus is tax incentives:

1. If the entrepreneur is involved in park improvement activities, without the right to carry out commercial activities on its territory. Tax incentives are provided, the amount of which is directly proportional to the percentage of the territory and the free placement of their advertising, the term of which is also proportional to the areas of improvement in the parks:

- improvement and support of 10% of the park's territory – respectively, the benefits amount to 10% of the company's annual tax, and 1 month of free advertising in one the types of the mass media;
- from 10 to 20% of the park's territory – 15% of the annual tax, 2 months of free advertising;
- 20-30% of the park's territory – 20% of the annual tax, 3 months of free advertising;
- 30-40% of the park's territory – 25% of the annual tax, 4 months of free advertising;
- 40-50% of the territory – 30% of the annual tax, 5 months of free advertising;
- 50-70% of the territory – 40% of the annual tax, 6 months of free advertising;
- from 70 to 100% of the territory – 50% of the company's annual tax, 8 months of free advertising.

2. If an entrepreneur creates a park at their own expense, they receive tax benefits depending on the regulatory satisfaction of the needs of the local population in green areas. The amount of tax benefits has the following ratios to the regulatory provision of greenery:

- 30-40% of the district's population – 15% of the annual tax;
- 40-60% – 25% of the annual tax;
- 60-80% – 30% of the annual tax;
- 80-100% – 35% of the annual tax.

At the same time, if an entrepreneur creates a park at their own expense, they have the right to conduct commercial activities that do not interfere with the environment according to sanitary and organoleptic standards and do not harm the environment. For example, a sports institution that creates a park has the right to place sports infrastructure and indoor pavilions for summer classes on the territory not exceeding 20% of the total area of the park. At the same time, the park should be located farther from the rural area, so that activities and recreation do not interfere with the surroundings.

3. If an entrepreneur takes care of the park under a lease agreement that does not provide for significant financing, they are entitled to 10% preferential taxation and 2 months of free advertising in one of the types of media in the current year.

It should be noted that in all three cases, the amount of funds that is a certain percentage of the tax can be returned to the entrepreneur in two ways:

1. Funds that make up the corresponding percentage of tax benefits can be returned to the company's account at the end of the current year;

2. Or there is preferential taxation of the company on a monthly basis.

Providing such economic incentives will have a positive impact on the field of park improvement, as well as the social and economic sphere in general:

- from an economic point of view, parks will become a profitable type of investment for enterprises and organizations, providing economic preferences;

- addressing the lack of parks funding for local budgets;

- stimulating the creation of new parks and providing the population with the necessary standards of green spaces;

- attracting both high-income entrepreneurs and small businesses to finance in the field of park improvement;

- creating a favorable image of an entrepreneur by meeting the needs of the urban population in green space, and therefore – focusing on the quality of landscaping work;

- creating healthy competition among landscape improvement enterprises, selecting the best projects, supporting and developing jobs in the field of landscape design and green landscaping;

- creation of the first sports facilities that provide their services outdoors, which is relevant for times of a pandemic.

Conclusions

An integrated approach to the development of parks, which is presented in the scientific article, will contribute to a comprehensive solution of the issues of their improvement in modern Ukraine. It is confirmed that promoting the development of parks from the point of view of their ecological, social and economic significance will have a certain positive impact on the relevant spheres, namely:

1. The social sphere: improving the quality of recreation in the parks; acquiring new opportunities to improve social welfare through the functioning of appropriate programs in the activities of the parks; partial transfer of social life into the natural space of the parks in forced isolation; improving

the level of sanitary and epidemic welfare; increasing the inclusiveness of social life through the consideration of the needs of all categories of people.

2. Environmental sphere: improving the quality of the ecological function of parks through institutional regulation of specific groups of ecosystem services, and the possibility of direct impact on the social and environmental problems of the city.

3. Economic sphere: additional financial resources in the field of park management, creation of new jobs and promotion of new economic ties.

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Міські парки як інноваційний соціальний простір і чинник суспільного й екологічного добробуту

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Анотація. Актуальність дослідження обумовлена тим, що ключовими вимогами до сучасних міських парків є їхня відповідність потребам суспільного простору разом з високим значенням у виконанні екологічних функцій. Суспільні та природоохоронні критерії устрою парків часто суперечать одне одному. Тому метою статті є представлення наглядного комплексного підходу щодо вирішення проблеми розбудови міських парків України та надання пропозицій щодо їхньої додаткової фінансової та інституційної підтримки. Основним напрямом методології наукового дослідження став системний підхід, а саме такі його аспекти: системно-елементний, системно-функціональний, системно-ресурсний та системно-комунікаційний. Внаслідок дослідження було з'ясовано важливість розвитку парків як суспільного простору, визначено їхнє рекреаційне значення для жителів сучасних мегаполісів, особливо під час пандемії COVID-19. Обґрунтовано важливість програмної підтримки груп екосистемних послуг парків, яка сприятиме їхній ефективній діяльності з погляду на соціальне та екологічне значення. Запропоновано як один із напрямів вирішення нестачі фінансування парків і стимулювання їхнього розвитку запровадження податкових стимулів та неринкових форм підтримки для підприємств, установ та організацій, які заохочували б їх до участі в благоустрої парків. Зазначено, що розміри податкових пільг залежать від активності підприємців у благоустрої парків та створенні нових зелених зон, і діють на добровільній основі. Практична цінність роботи полягає в тому, що рекомендації можуть бути використані органами влади в процесі розробки програм утримання, фінансування та діяльності парків, з метою підвищення їхньої природоохоронної та соціальної ефективності у благополуччі міст

Ключові слова: екосистемні послуги, парки, соціальне спрямування, фінансування, інституційне регулювання

Rural Tourism: Diversification and Modernisation of Tourist Infrastructure (on the Materials of the Transcarpathian Region)

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Abstract. In modern conditions, one of the promising areas of diversification of the rural economy in the Transcarpathian region is the rapid development of rural tourism. This is largely due to the concentration of unique natural and climatic, historical, cultural, and national-ethnic resources in rural areas. The assigning of tourism as one of the important priorities of rural economic development in decentralisation has intensified research to study the main trends in rural local tourism markets, the efficiency of tourism and recreational resources, and the level of tourism infrastructure, the quality of which creates an integrated tourism product to meet needs of tourists. The research aims to analyse and assess the level of development of functional tourism infrastructure and its impact on the efficiency of local rural tourism markets, the quality of tourism services, and outline promising areas for its development. By the purpose of the article, considerable attention is paid to the analysis of the existing network of health resorts, tourist and recreational facilities that make up the material and technical base and infrastructure of tourism. Given that the most popular type of tourism in the region is rural green tourism, the paper clarifies the main factors that determine its rapid development. Much attention is paid to the analysis of factors that negatively affect the development of tourist infrastructure. It is proved that the weakest link in the infrastructure chain of the market of tourist services is the state of development of "soft" infrastructure. The perspective directions of the development of "soft" infrastructure of rural tourism are outlined, focusing on the development of innovation-institutional, innovation-organisational, information-communicative, and security components. It is proved that the development of "soft" tourist infrastructure is an important area of diversification and modernisation of the rural economy, which in combination with socio-mental modernisation can ensure sustainable development of rural areas of Transcarpathia

Keywords: rural tourism, infrastructure, territorial communities, modernisation, diversification, decentralisation

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Introduction

The urgency of the study of this problem is determined by the fact that Transcarpathia has the necessary prerequisites for the development of tourism – the presence of landscapes, unique ecosystems, natural and cultural monuments, recreation centers, health facilities, significant labor potential, especially in rural areas. These factors allow developing various types of active and cognitive recreation, to form their tourism product and successfully sell it on the Ukrainian and foreign markets to attract foreign tourists. Assessment of the natural resource potential of the region indicates that a significant share in their structure is occupied by tourist and recreational resources, the use of which in economic terms is possible only through the development of various tourism activities and their priority areas. The inclusion of tourism entrepreneurship in the sphere of economic priorities becomes an important factor in intensifying the processes of economic life in rural areas, creating the basis for the transition from a mono-sectoral structure of the rural economy to multifunctional development of rural areas [1]. The existing tourist and recreational potential, together with the high propensity of the region's population to entrepreneurial activity, require the implementation of a rational, purposeful policy in the tourism sector, which lays the foundation for creating a modern and competitive tourist complex. In particular, rural territorial communities, such as Transcarpathia is the least urbanised region of Ukraine. Development of tourism in the region can be seen as a tool of solving the problem of employment of the rural population, especially young people because the tourism business has a clear youth profile and thus stabilises the situation in local rural labor markets, and minimises large-scale labor migration, the core of which is youth. Sociological monitoring conducted in the Zakarpattia region in 2018-2020 by scholars from the Regional Center and Mukachevo State University to study the migratory activity of student youth showed high migratory sentiments of respondents, especially among students of vocational schools, where 39.2% would leave the region if possible, 13.8% would go to a permanent place of residence abroad, and 13.8% would go for a few years to improve their financial situation; among university students the answers to these questions were distributed respectively – 20.8% and 21.7% [2]. The second important issue solved by the development of the tourism business is the expansion of the source base of local budgets of territorial communities, as evidenced by the experience of many countries, where tourism is an important area of the economy.

To develop domestic and outbound tourism, it is essential to understand the need to study regional tourism resources and their rational use [3; 4]. Today, the tourism business in Zakarpattia is at the stage of structural transformation, institutional formation, and formation of intra-sectoral, intersectoral, and foreign economic relations. Analysis of socio-economic programs of local communities indicates that the vast majority of them attribute tourism to the strategic priorities, which significantly increases the im-

portance of the in-depth study of theoretical doctrines and mechanisms of the tourism market, development of functional and general infrastructure that balances demand and offer for tourist services and support of local tourist markets in equilibrium.

Therefore, according to the above, the purpose of the research article is to determine the level of development of the functional component of tourism infrastructure, its impact on the quality and efficiency of tourism services within rural local tourism markets, and identify promising areas for further development.

Literature Review

The active development of rural tourism, its transformation into one of the important catalysts for the socio-economic development of rural areas, has significantly intensified scientific research on this issue. This is because the accelerated development of rural tourism, namely green, ecological, and agritourism [3] can minimise labor migration processes.

Analysis of scientific publications indicates the multifaceted nature of the research problem. In particular, in the works of I.V. Berezhna [4], M.I. Dolishny [5], V.I. Matsola [6], D.V. Nikolaenko [7] the issues of essence and analysis of tourist and recreational potential, its component structure, methods of economic assessment of natural resources based on differential rent are investigated. The researcher V.S. Kravtsiv in his scientific works considers the potential of the recreational component of the Carpathian region, as well as provides an analysis of the legislative and regulatory framework for the regulation of the recreational sphere [8]. For her part, V.H. Ivanova focuses on the concept of "rural tourism", according to which she carries out a correlative analysis of "rural tourism" and "agritourism", as well as proposes the legislative and regulatory design of these concepts [9]. The scholar V.V. Papp provides practical advices on implementing and improving the efficiency of rural tourism on the example of creating tourism routes of different targets [10]. A similar research topic was chosen by such authors as L.Yu. Matviichuk, I.V. Tyshchuk [11], T.I. Tkachenko [12], A.V. Babkin [13], V.F. Kyfiak [14] in particular, these researchers deepen the content burden on the structuring of rural tourism, green tourism, agritourism, and ecotourism.

Research of problems of formation, functioning, and development of infrastructure of the market of tourist services was reflected in works of V.D. Beznosiuk [15], V.Ya. Brych [16], V.S. Mazur, O.V. Muzychenko-Kozlovska [17], A. Holod [18]. At the same time V.V. Hoblyk [19], N.V. Kostenko [20], K.A. Dudkina [21], I.V. Davydenko [22] consider the components of the formation and implementation of innovative policies for the development of tourism and recreation, the place and role of clusters in it as a mechanism for using resources and integrating efforts to solve the problem of the region.

However, many problems related to the effective development of the tourism sector, especially its rural segment, the development of innovation infrastructure are

insufficiently studied, which harms the practical solution of this problem. Hence, the relevance and importance of scientific analysis of the functioning of local rural tourism markets, and the need for an integrated approach to the development of tourism infrastructure as an important subsystem of the rural economy.

Materials and Methods

The research on the selected issue of rural tourism was conducted in two stages. The first stage of scientific research involved providing a general description of the rural tourist infrastructure of the Transcarpathian region based on the analysis of the theoretical basis of the study, based on the works of Ukrainian and foreign scientists, as well as passports of rural settlements, data from the bodies of State Statistics, and the program of development of tourism and resorts of the Transcarpathian region for 2021-2023 [1]. The second stage of the research was aimed at identifying key components of the potential development of rural tourism infrastructure in Transcarpathia, in particular, such as innovation-institutional, innovation-organisational, infocommunicational, and security components. At the same time, during the second stage of the study as additional information on the state of trends in rural tourism and the level of infrastructure, the authors used data from a sociological experiment, which covered about 450 owners of rural estates providing tourism services. The level of comfort and service, quality of food, tourism software, effectiveness of safety measures, availability of additional conditions for children's recreation were registered. The study of the impact of these factors on the growth of demand for tourism services is important from an instrumental and theoretical point of view, as they allow to identify empirical data on key indicators that affect the development of rural tourism.

In the process of research a set of general scientific research methods was used – synthesis, analysis, inductive and deductive methods, etc., as well as special methods – monitoring of owners of rural estates, rural entrepreneurs, employees of local governments. In particular, the methods of analysis and synthesis were used in the process of processing the source base of the study during the first stage of scientific research. The statistical method of research was used to describe the material and technical base and infrastructure of tourism in Transcarpathia, key tourist areas, characteristics of personal farms and private estates of villagers who provide tourist services, etc. The method of induction helped to consider the general state of the tourist infrastructure of rural areas of the Transcarpathian region in the aggregate of its individual components. The method of deduction was applied in the process of characterisation of perspective directions of development of rural tourist infrastructure of Zakarpattia region. In addition, the method of data processing was used while analysing the statistical indicators. The method of systematisation helped to visualise the main forms of Internet use in the provision of tourist services and the scheme of the impact of diversification and modernisation of the infrastructure of the tourist services

market on socio-economic development of rural settlements on the example of Transcarpathia. The generalisation method was used to summarise the research and make recommendations for improving rural tourism.

Therefore, the study was built in accordance with the principles of structural-formal and systematic approaches, which contributed to the comprehensive consideration of rural tourism in the context of such aspects as diversification and modernisation of tourism infrastructure.

Results and Discussion

General characteristics of the tourist infrastructure of Transcarpathian rural areas

Transcarpathia has significant recreational and tourist resources, which are not only national but also international. With a few exceptions, the entire territory of the region is characterised by exceptionally favorable, natural, and climatic conditions and the availability of various recreational and tourist resources for active recreation and health of people, conducting various types of tourist activities. Available natural, historical, cultural, and socio-economic resources, which together form the recreational and tourist potential, which means “components of the geographical environment and objects of anthropogenic activity, which due to such properties as uniqueness, historical or artistic value, originality, aesthetic attractiveness, and health significance” [23] turn the region into a center of recreational and tourist activities in Ukraine. Today this fundamental moment determines the directions, intensity, and dynamics of structural reforms in the economy of Transcarpathia, making the tourism and recreation sphere one of the most important economic priorities. The inclusion of tourism in the priority areas of management has given a positive impetus to the development of tourism infrastructure, the level of development of which is one of the most significant factors of attractiveness and competitive advantage in providing tourism services, achieving their high quality. The network of health resorts, tourist-recreational and hotel establishments, which make up the material and technical base and infrastructure of tourism, today has 511 objects, in particular: 148 hotels, 18 sanatoriums, 362 tourist objects and mountain shelters, 10 motels, 4 hostels. There are 105 developed tourist routes in the region, the total length of which is 204.9 km, many of which are marked. There are 63 ski lifts and 44 ski equipment rental points in the mountain settlements. The dynamic development of tourism is facilitated by a developed network of nature reserves, including 459 objects, the most important of which are 3 national parks, 1 regional landscape park, 19 reserves of national and 49 of local importance, 329 natural monuments of local importance. The number of business entities operating in the market of tourist services is growing rapidly. During 2015-2020, there was a significant increase in tour operators, the number of which increased from 67 to 91, there are 25 tourist information centers. The development of rural tourism in its various forms is characterised by positive dynamics – green, eco- and agritourism, weekend tourism, etc.

Unfortunately, the ability to analyse trends in rural tourism, its impact on the socio-economic development of rural settlements are limited by available statistical information that is incomplete or discrete. Therefore, the problem of assessing its dynamics of development of existing infrastructure, material and technical base is studied based on individual scientific approaches, sample statistical materials, passports of rural settlements, programs of socio-economic development of communities, expert assessments.

The analysis of the received array of information indicates the rapid development of rural tourism, which functions as a self-employed type of entrepreneurial activity based on personal farms and private estates of villagers to provide tourist services. The number of rural estates providing tourist services exceeds 600 units. For comparison, in 2018 their number was 460 units. As a result of the quantitative growth of business entities in the field of tourism in the region several local tourist areas were formed with centers in Yasinya, village Kvasy – Rakhiv district, village Vishka, village Uzhok, village Lumshory, st. Vojvodina – Uzhhorod district, village Pylypets, village Synevyr, village Soimy – Khust district, village Polyana – Mukachevo district. Their functioning indicates that a relatively new segment of tourism entrepreneurship is being formed in rural areas of the region – rural green tourism – as a specific form of recreation based on rural estates, which is gradually becoming a priority area of economic activity in rural areas.

The rapid development of rural tourism in its various forms is determined by the action of many factors that reinforce each other:

- first, the development of rural tourism in Transcarpathia has a history. Back in the 1930s lovers of rural exotics came to rest in the families of wealthy villagers from Prague, Bratislava, Budapest, and other European countries [24];
- second, the implementation of the multiplier effect of tourism entrepreneurship on the development of compatible and interconnected areas of the economy;
- third, the importance of rural tourism for the preservation and reproduction of local culture, folk customs and traditions, social integration of rural residents, expansion and strengthening of social ties both within the rural community and outside it [25];
- fourth, the realisation of a positive effect of scale due to the real ability to respond quickly and flexibly to fluctuations in demand for tourism products in the market of tourism services;
- fifth, the monitoring of local community development programs carried out by researchers from Transcarpathian Regional Centre for Socio-Economic and Humanities Research of NAS of Ukraine showed that the vast majority of communities link the prospects of their economic development in the context of decentralisation with the development of tourism business [26].

There are several other arguments, but the above is enough to understand the importance of rural tourism in community consolidation, acquisition of skills of collective action and cooperation of rural enterprises to serve the

tourism sphere, improving rural infrastructure, organising cultural and artistic events, solving rural employment issues, slowing down labor migration processes, reducing the poverty of the rural population. At the same time, the analysis of the efficiency of rural estates providing green tourism services shows that the capacity utilisation rate is 0.17 (in Lviv region – 0.23), the average length of stay of visitors decreased in rural estates located in traditional rural green tourism centers in regions from 3.4 to 2.7 days. The increase in the actual costs of rural estates per capita (from 104.4 to 117.8 UAH) reduces the economic efficiency of their activities, which can significantly limit the development of rural green tourism in the future [25]. The further development of rural green tourism is also complicated by the fact that it has less investment attractiveness for potential investors compared to other areas of capital investment in rural areas, including logging and agriculture. The reason for this is the lack of strong positions of the recreational complex in the international market of services, the need to invest much more than other areas, and low capital turnover in this area, and thus a longer payback period [26]. As a result, a serious problem in the tourism sector is “inconsistency of tourism infrastructure with the world level and modern requirements of the tourism market and low-quality tourism services, lack of favorable investment climate, leading to underdeveloped social infrastructure, insufficient staffing, management of the tourism industry” [27].

Given the above it becomes obvious that in the post-industrial model of development the key problem is the modernisation and diversification of the infrastructure of the regional tourism market, which means “a set of measures aimed at improving and updating facilities, institutions, organisations, communications, infrastructure, etc., bringing them in line with requirements and standards, technical conditions, quality indicators” [28].

In the infrastructural segment of rural settlements of the region, the road transport infrastructure has a significant impact on the development of tourism. An objective analysis of the state of the road surface and transport infrastructure shows that the implementation of the presidential program “Large Construction” opens wide opportunities for the development of tourism business in rural areas and makes them logistically and investment-attractive. Significant prospects for tourism development are opening up in connection with the implementation of the Small Carpathian Circle project, which envisages the construction of 132 km of roads in the Zakarpattia region. Thanks to the project, well-known tourist centers will be connected with modern road surfaces: Dyda and v. Yanoshi, Berehiv district, village Pylypets, village Izki, village Synevyrska Polyana in the Mizhhirya region, which will significantly reduce travel time. The project is also important because it opens space for intensifying interregional and international tourism ties, as European-level roads are planned to connect the famous resorts of the western regions of Ukraine and neighboring European countries – Poland and Romania.

At the same time, the unsatisfactory condition of

local roads remains an acute problem, accounting for 72.4% of the length of public roads. The quality of the road surface in the direction of mountain villages – centers of rural green tourism, in the assessment of the local population on a 5-point scale was distributed as follows: excellent – 3.25% (7 settlements), good – 21.3% (46 settlements), satisfactory – 23.3% (49 settlements), unsatisfactory – 46.9% (115 settlements). The high proportion of low-quality roads is a serious barrier to “many historical monuments, numerous tourist and recreational sites in Transcarpathia, especially in mountainous areas” [29]. Due to underfunding of the need for construction and maintenance of local roads in rural areas, there is virtually no roadside drainage, poor road maintenance in winter, no equipped car and bicycle parking lots. The current situation requires state support for infrastructure projects that require capital investment for the development of the network of public roads of local importance. Especially important is the creation of a wide direction of the highway Yasinya (highway H-09) – Uzhok (highway H-13), change of status, and reconstruction of the technical category of territorial highways T-07-22 Uzhok – Pidpolozya, T-07-18 Nyzhni Vorota – Volovets – Mizhhiriya and sections of highways T-07-020 Mizhhiriya – Kolochava – Bushtyno, T-07-28 Kolochava – Ust-Chorna – Kalyny – Bedevlya, forest road Lopukhiv – Yasinya. The construction and reconstruction of these roads are essential for the development of tourism, as they will connect all local tourist centers of Transcarpathia into a single node. This project can be implemented only based on public-private partnership, as there is a high share of roads of national importance, and the total cost of repairs is estimated at 4.580 billion UAH. No less significant is the development and arrangement of bicycle paths and road service facilities along highways in Khust, Tyachiv, and Rakhiv districts. The development of motorcycle tourism, heavy transport (jeeps, quad-bikes, etc.) can have a significant impetus for the development of tourism in the Berezhnianshchyna region, provided that tourist routes are determined in a way that ensures respect for the natural environment.

The transformation of the sectoral structure of the economy of rural settlements in the region associated with the priority development of tourism is radically changing approaches to the formation of “soft” infrastructure. Today, it is the weakest link in the infrastructure chain of the tourism business. At the same time, the experience of many European countries shows the strengthening of its impact not only on tourism but also on economic growth. This term aggregates financial, innovative, institutional, informational, socio-cultural, and economic-legal, as well as business entities that maintain and ensure normal living conditions and the economy, health care, sociocultural sphere. In the tourism sector, this is a key component of maintaining competitiveness, based on which inter-municipal cooperation is intensified, inter-sectoral relations, optimisation of species specialization of tourism activities. The development of soft infrastructure involves investing in new technologies in the tourism sector,

the development of communication, the promotion of tourism services to the requirements of state standards, strengthening the interaction between business and NGOs. In the context of decentralisation, the catalyst for the development of soft infrastructure in rural areas is local communities, represented by local governments. In the field of tourism business, their task is to initiate the creation of innovation infrastructure, “industries, services, which are a set of innovation, information, advisory, educational, and other centers that can support all stages of innovation” [30].

Components of rural tourism infrastructure development in the Transcarpathian region

Based on numerous scientific studies, innovation processes in the development of rural tourism infrastructure in the Transcarpathian region should focus on the development of innovation-institutional, innovation-organisational, infocommunicational, and security components.

The development of innovation and institutional infrastructure involves increasing the role of the community council in stimulating and supporting business in the field of tourism. This requires, along with the functioning of the general, special, informational, regulatory infrastructure, the formation of a local network of tourist information centers of various forms of ownership in each rural territorial community. Their activities should ensure the transfer of new technologies in the tourism sector, building clear relationships and cooperation between business entities, exchange of positive experiences, transfer of new knowledge. Support of competition, the introduction of innovations, commercialisation of knowledge, and learning processes – these functions are the essence of their activities.

The development of innovation and organisational infrastructure is especially important. The research of mountain territorial communities of the region in the context of the perspective of their development in the conditions of decentralisation showed that 23 out of 24 studied communities assigned the development of tourism as one of the priorities. By types of tourist services, 23 communities plan to develop green tourism, sports – 7, environmental, equestrian, and hiking – 2 communities and only Velykobyckivska territorial community, except for the village Meadow does not link the prospect of economic development with tourism. The high share of communities whose socio-economic development is associated with the priority development of tourism makes it objectively necessary to form tourism clusters, which today are becoming an essential element of the creative economy. Structurally, they could include financial institutions as potential investment donors, advertising agencies, travel information centers, research institutions, business incubators, travel agencies. In essence, these structures will functionally provide tourism businesses with special skills, technologies, information, knowledge, capital, and information, which will significantly increase their competitiveness in the market of tourism services. The most promising in terms of resource provision in rural areas of

the region is the organisation of clusters by specialisation: green tourism (Khust, Tyachiv, and Rakhiv districts), health (Mukachevo district), cognitive and ecological (Rakhiv district), which will create a tourist and recreational product with the introduction of SMART specialisation to develop health tourism. Given the growing demand, the creation of a sports cluster is promising, in particular for the use of heavy vehicles on mountain routes (jeeps, motorcycles, ATVs) in the Berezhnyansk region. The cluster model of a business organisation allows its participants to combine their efforts to get an emergent effect, compared to what they would get by operating separately. It is equally important that clustering creates the basis for the creation of an integrated tourism product, which significantly improves the quality of services and meets the needs of tourists. This is confirmed by the activities of one of the first microclusters of ecotourism "Oberig" in Ukraine, which unites 10 agro-villages and more than 60 people (owners of agro-villages, guides, shop owners, etc.).

An important part of rural tourism infrastructure is its innovation and communication component. In the conditions of formation of information society along with traditional sources of information, the role of information and communication technologies which have a significant influence on the efficiency of functioning of rural tourism essentially grows. SWOT-analysis of the development of tourism in the region allows, with limited access to sources of information, to identify many serious problems that hinder the competitiveness of rural enterprises, namely:

- insufficiently developed infrastructure and communications, especially to remote rural tourist centers and territories, insufficient number of bilingual tourist signs and route markings (out of 105 developed tourist routes only a few of them are marked);
- non-compliance of the activity of tourist-infrastructure centers and centers for the promotion of tourist services with the requirements of state standards;
- insufficient information of tourists about the available excursion, animation, and other tourist services and products;
- weak connection of rural enterprises operating in the field of tourism business with tour operators and travel agents, the regional market of tourism services.

The noted weaknesses harm the development of rural tourism, as tourism is an information-dependent area, where new technologies and means of promoting new tourism products are tested. Expanding the possibilities of communication for the development of rural tourism is provided by modern infrastructure technologies – electronic and on-line communication using digital devices. The prospects of digital communication (e-communication) in the current conditions open rural businesses access to the Internet, without which today it is almost impossible to carry out tourism activities. Consumers of the tourism market feel the need for information (detailed description, photos, reviews), which cannot satisfy either the print media or, moreover, such media like television and radio. Of particular interest in the organisation of rural tourism are the following forms of Internet use (Fig. 1):

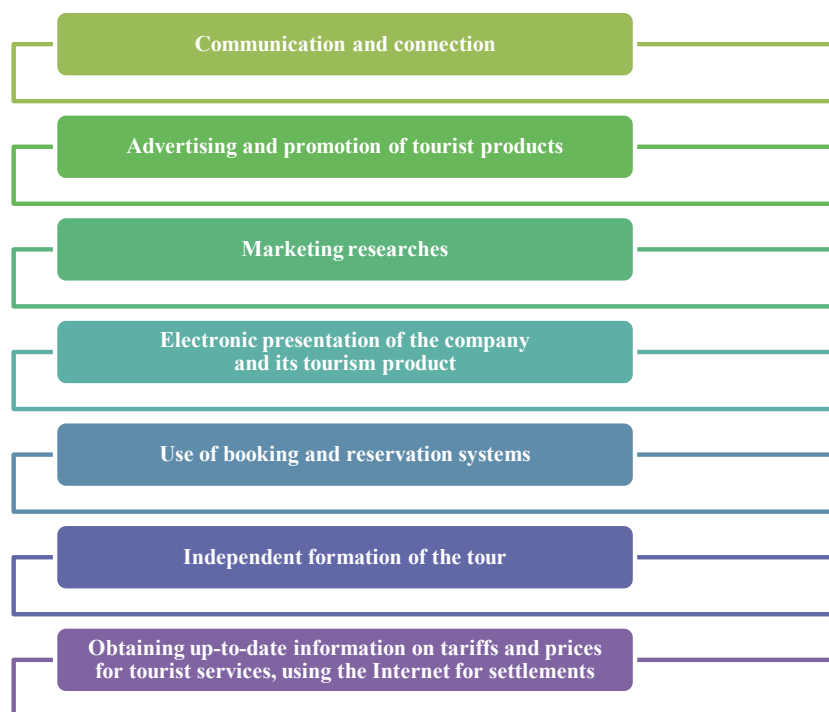


Figure 1. Forms of using the Internet in the process of organising rural tourism

According to the above, it is obvious that such factors as the development of the Internet in rural areas, its quality functioning, increasing the number of Internet users today are among the most important prerequisites that will determine

the vector of rural tourism in the region. The growing demand for active tourism – water, mountain, hiking, skiing, speleology, quad biking, jeeps, motorcycles, etc. – requires the development of security infrastructure. This is because

active tourism involves tourists in the natural environment, usually remote from rural settlements, which does not exclude the danger and threats to their health.

Ensuring safety standards and norms on active tourist routes requires a comprehensive approach to its solution. On the one hand, this requires improving the general culture of tourists and promoting safety and a culture of safe routes. This is achieved through improved information support, in particular:

- issue of special methodological literature on the technique of passing routes;
- conducting interviews and briefings with tourists on environmental safety;
- issue of cartographic and information material, reflecting possible obstacles, marked routes, shelters, medical care points.

On the other hand, no less important task is to ensure the safety of tourists in rural estates, summer houses, bases, campsites. This requires local governments to monitor compliance with building codes and regulations in the

design and construction of tourist facilities, safety requirements for maintenance of buildings, structures, and equipment established by regulations, guarantee the personal safety of tourists and the safety of their property. Equally important issues related to tourist safety are the uniform placement of rescue teams in rural settlements and the organisation of rescue centers in places of mass tourism, which must have proper communication with all actors in the community and the region. The outlined range of problems related to the provision of real assistance to tourists in the event of an emergency will create a highly effective security system in any emergency.

Thus, the development of “soft” infrastructure, in particular, its important links such as innovation-institutional, organisational, information-communication, and security can diversify and modernise the tourist infrastructure of the village, create an integrated tourism product, implementation of the multiplier effect on socio-economic development of rural settlements (Fig. 2).

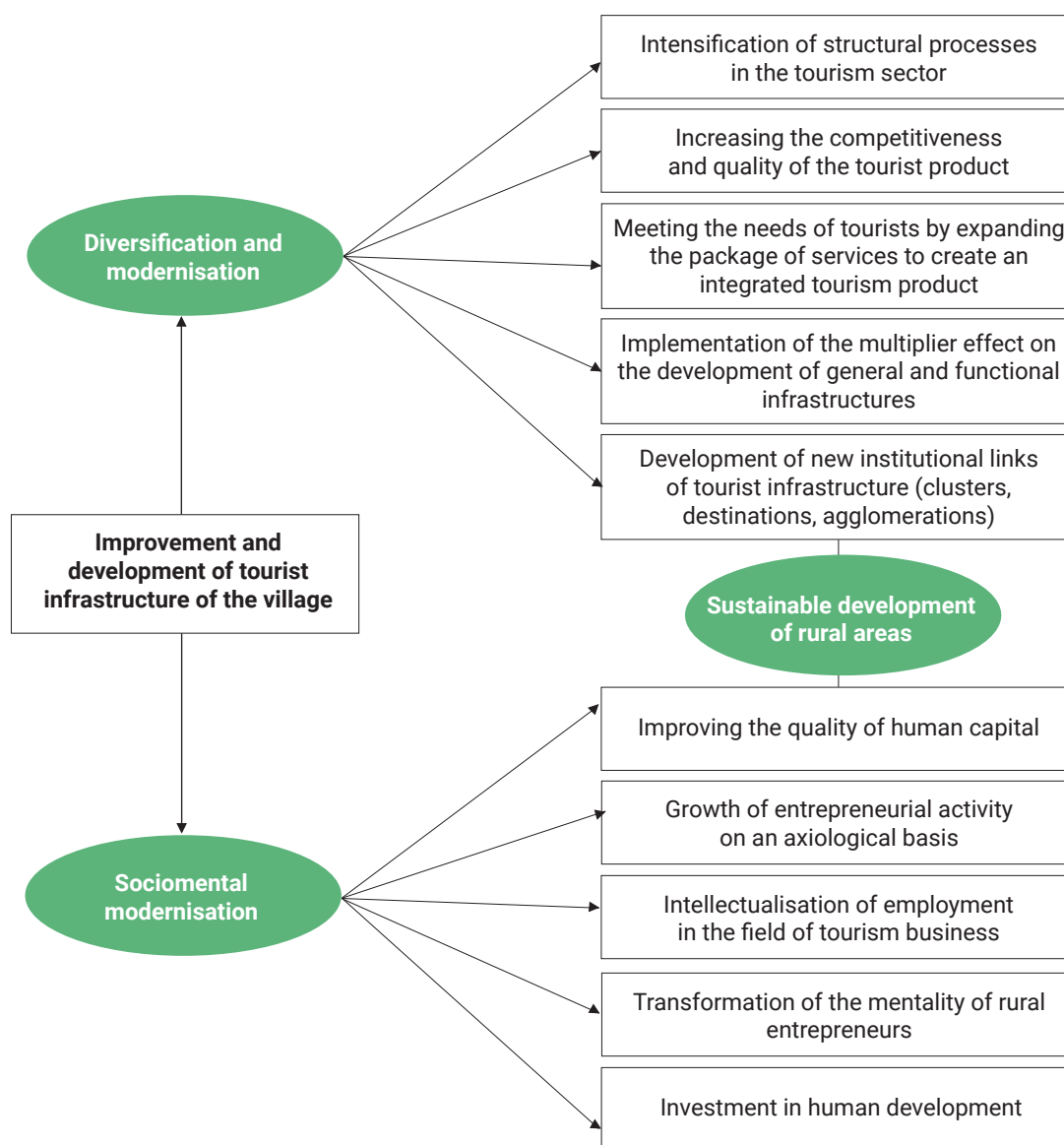


Figure 2. Algorithm of influence of diversification and modernisation of infrastructure of the market of tourist services on social and economic development of rural settlements

Source: authors' own development

Thus, the innovation component becomes the defining dominant of the process of modernisation of rural infrastructure of the tourist services market, as it can have a direct impact on the intensification of structural processes in tourism, ensure high-quality tourism services, offer an integrated tourism product, form new institutional infrastructure links, agglomerations, innovation centers, etc.

Under the influence of these processes, there is a profound transformation in the development of the human capital of the village, which acts as a strategic resource and a factor in the socio-economic growth of tourist destinations, ensuring a careful attitude to the use of tourist locations. Hence, the profound changes in the mental and psychological attitudes of rural society, the formation of which is carried out on axiological principles, which open space for cultivating a system of values, in particular in business – the need for self-development, skills management, and marketing, creativity, strengthening local entities. Of course, it is almost impossible to solve this complex problem by rural communities, which requires state support for infrastructure projects that require significant capital investment, public investment in science, new technologies, innovation,

entrepreneurship, human capital, education, health care, i.e., those areas that are organically related to tourism [31].

Conclusions

The analysis of the main functions implemented by infrastructure units in conjunction with the local-specific nature of the subregional markets of rural tourism services indicates that the tourism infrastructure has a clear network nature, as it organically interacts with social and socio-cultural, takes an active part in the creation of a tourist product, and ensures the effective operation of all economic entities. This leads to an important conclusion, the essence of which is the need to develop infrastructure comprehensively, as it is a complex subsystem of the rural economy in which all links are correlated. A comprehensive assessment of the level of dynamics of its development should be carried out to study the existing problems of each infrastructure facility and take preventive measures to optimise their activities. The economic essence of rural infrastructure is that the higher the level of its development, the more attractive it is for investment, innovation, the attraction of highly qualified workers in the field of tourism.

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Сільський туризм: диверсифікація і модернізація туристичної інфраструктури (на матеріалах Закарпатської області)

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Анотація. У сучасних умовах одним із перспективних напрямів диверсифікації сільської економіки в Закарпатській області є швидкий розвиток сільського туризму. Цьому значно сприяє зосередження в сільській місцевості унікальних природо-кліматичних, історико-культурних і національно-етнічних ресурсів. Віднесення туристичної сфери до одного з важливих пріоритетів розвитку сільської економіки в умовах децентралізації активізувало наукові пошуки дослідження основних тенденцій функціонування сільських локальних туристичних ринків, ефективність використання туристично-рекреаційних ресурсів, рівень розвитку туристичної інфраструктури, якісне функціонування якої створює можливість надання інтегрованого туристичного продукту з метою задоволення потреб туристів. Метою наукової роботи є аналіз та оцінка рівня розвитку функціональної туристичної інфраструктури та її вплив на ефективність функціонування локальних сільських туристичних ринків, якість наданих туристичних послуг та окреслення перспективних напрямів її розвитку. Відповідно до поставленої мети у статті значна увага приділена аналізу наявної мережі оздоровчо-курортних, туристично-рекреаційних об'єктів, які становлять матеріально-технічну базу та інфраструктуру туризму. Враховуючи те, що найбільш масовим видом туристичної діяльності в регіоні є сільський зелений туризм, в роботі з'ясовано основні чинники, які детермінують його швидкий розвиток. Значна увага приділена аналізу чинників, які негативно впливають на розвиток туристичної інфраструктури. Доведено, що найслабшою ланкою в інфраструктурному ланцюгу ринку туристичних послуг є рівень розвитку «м'якої» (soft) інфраструктури. Окреслено перспективні напрями розвитку «м'якої» інфраструктури сільського туризму, зосередивши увагу на розвитку інноваційно-інституційної, інноваційно-організаційної, інформаційно-комунікативної та безпекової складових. Доведено, що розвиток «м'якої» туристичної інфраструктури є важливим напрямом диверсифікації та модернізації сільської економіки, що в сукупності з соціоментальною модернізацією здатні забезпечити сталий розвиток сільських територій Закарпаття

Ключові слова: зелений туризм, «м'яка» інфраструктура, територіальні громади, модернізація, диверсифікація, децентралізація

Analysis of the Dynamics of Foreign Currency Exchange Rates in Ukraine Including Seasonality Factors and Demand for Domestic Government Loans Bonds (Over 5-10 Years)

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Abstract. The relevance of the scientific article lies in the need to substantiate the importance of the role of currency exchange rates for the robust functioning of the country's economy. The purpose of the article is to analyse the dynamics of foreign currency exchange rates, mainly the dollar, and the euro, in Ukraine, taking into account factors of seasonality and demand for government bonds. The main methods used in the paper are statistical empirical research methods, in particular modelling. It was determined that the export of raw materials, mainly steel, and various agricultural crops such as wheat, corn, sunflower oil, soybeans, etc., plays a particularly important role in Ukraine. It was found out that the mentioned fluctuations in export are one of the reasons for the currency seasonality, but not the only one or the main reason, as the exchange rate is strongly influenced by oil, gas, and other energy resources prices, which the country needs constantly, especially during the heating season. The exchange rate of the hryvnia over the last five years within the context of the National Bank of Ukraine has also been analysed. It was found that the demand for government loans bonds is one of the most important factors in considering the foreign currencies exchange rates in Ukraine. To make models more plausible and to reduce the influence of other factors in determining seasonality of the currency with certain currency pairs with the dollar, euro, yen, zloty, and ruble, the data for the last several years has been used, which are less likely to be distorted by the influence of external factors. It has been confirmed that a successful trade policy is a key source of currency stabilisation in Ukraine. The article is useful for studying the functioning of currencies in general; for studying the economy of Ukraine, especially the country's currency issues; for students of various economic disciplines

Keywords: Ukrainian economy, currency exchange rates, seasonality, bond market, finance

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Introduction

An overview of the financial sector has always been important for the analysis of a national economy that has the real (goods and services markets) and, in particular, the financial sector interacting closely [1]. According to many academic economists, the foreign currency market is one of the most important macroeconomic indicators, which has a major impact on a range of economic processes [2]. Over time, this role is only increasing. Nowadays, the foreign currency market and its functions are an integral part of the financial market [3]. This is primarily due to globalisation processes in the world, as well as some political processes and even modifications in the form of currencies as such. The stability of the national currency is important for a healthy relationship with foreign partners. Therein lies the relevance of the research.

For Ukraine, as a developing country with economy in transition, it is important to support its national currency, the hryvnia, as the currency exchange rate is of great importance in the improvement of currency relations as well as in the formation and regulation of a normal foreign currency market [4]. This support can be provided through various instruments, including direct interventions by the National Bank of Ukraine (NBU). Nevertheless, the hryvnia is a relatively volatile and unstable currency, which exchange rate, especially in the past, was very similar to that of the ruble, which was due to the significant amount of ties that remained between the countries since the existence of the Union of Soviet Socialist Republics (hereinafter, the USSR). Now the trend is not so pronounced. Nevertheless, with all the attempts to diversify the economy, Russia still takes a large share of the country's exports and imports.

Throughout its history, the Ukrainian currency has continually devalued. For example, at the time of the currency's introduction, the dollar exchange rate was 1.76 hryvnia and held for some time in front of the 2-hryvnia mark. However, by 2000, the rate reached 5 hryvnias per dollar, by 2008 – 8 hryvnia, by 2014 to 16 hryvnia, and 2015 to 26 hryvnia. Currently, the rate fluctuates within the range of 26 to 28 hryvnia per dollar. Such instability was caused not only by problems within the country but also by the global crises, which, due to the openness of the Ukrainian economy, like many other post-Soviet countries, severely affected both the economic situation in the country as a whole and the exchange rate. According to some international organisations, the currency will stay in the same range and slowly devalue towards the 30 hryvnias per dollar point. The Ukrainian budget for 2022 projects the exchange rate to be around 28.6-28.7 hryvnia per dollar [5]. In fact, such a gradual and projected rate depreciation could have some kind of positive impact on economic development through increased exporters' revenues.

Although the currency exchange rate is influenced by many factors, the determining factor in its formation belongs to the market [6]. It has already been described in the abstract that in Ukraine the fluctuations of the dollar

exchange rate are seasonal, which will be shown and described in more detail in the paper itself. However, it is also important to note that other factors, such as the issuance of domestic government loans bonds, affect the exchange rate too. They are issued every Tuesday, which leads to currency strengthening. At the moment, Ukrainian securities are quite attractive for foreign investors in terms of profitability, which also has an impact on the hryvnia strengthening [7].

Thus, *the paper aims* to analyse the dynamics of the Ukrainian currency exchange rate, based on seasonality factors and demand for domestic government loans bonds. The object of the study is the hryvnia/euro and hryvnia/dollar exchange rates over the last few years. The novelty of the paper lies in the absence of such an analysis of Ukrainian national currency exchange rates in modern economic literature.

Materials and Methods

The methodology of the article is based on statistical research methods, as the paper itself is an analysis of the dynamics of exchange rates in Ukraine over the past 5 years. The paper uses empirical statistical data, as well as the statistical calculations supported by tables and graphs, on the basis of which conclusions are drawn about the interaction of factors. In addition, theoretical research methods are applied to analyse the data not only on the statistical side but also their economic interpretation. In particular, based on theoretical conclusions about the factors which influence currency exchange rates, statistical analysis was carried out to empirically confirm the relationship between the factors. In the course of this study, numerous scientific papers, reports, documents, and other publications were analysed. The currency market of Ukraine was researched and the latest news related to its functioning was studied. The research method applied: historical; abstract-logical; statistical methods (modelling, forecasting, statistical observation, graphical method); monographic method, abstraction.

There are a large number of theories and approaches to currency exchange rate formation in modern economic thought [8]. To conduct a statistical study on the effect of seasonality on the exchange rate of the hryvnia, an adaptive model was used, which met this objective better than a multiplicative model. The results were the most plausible and realistic, which is most likely due to the inconstant differences in seasonal deviations of currency exchange rates. The most frequently used statistical techniques in the paper were non-linear regression analysis and correlation analysis. Regression was chosen due to its ease of understanding and versatility. For the most part, there was no clear relationship between the factors, even though it should have existed from the theoretical point of view. The fact is that there was mostly a non-linear relationship between the factors, namely hyperbolic rather than linear, which was the reason for the non-linear regression analysis. Correlation analysis is also widely used for the same purpose (confirming factor relationships). Many graphs and tables are included in the

article in order to clearly show the described and induced relationships. Other analysis methods such as fundamental and technical analysis can also be used, but will not be applied in the course of this study [9].

The research on this topic was conducted in three stages. The first stage involved a general analysis of the hryvnia: its volatility, the influence of the National Bank of Ukraine (NBU) on its exchange rate, and recent trends in the exchange rate influenced by changes in the price of certain resources, etc. The second stage provides an analysis of currency seasonality with several currency pairs, the dollar, the euro, the yen, the zloty and the ruble; it shows which currencies demonstrates stronger seasonal variations and which has weaker seasonality and what it is associated with. In addition, the impact of a country's exports and imports in different months on the currency exchange rate and its seasonality is shown. The third stage demonstrates the impact of the demand for domestic government loans bonds on the currency exchange rate, as well as the effect of changes in average domestic government loans bond rates on the exchange rate. The conclusions on the impact of the analysed factors on foreign currency exchange rates in Ukraine are provided at the end of the study.

Results and Discussion

As mentioned above, the hryvnia is a very volatile currency, with a monthly standard deviation of 1.14 UAH, or roughly 4% of its value over the past five years (the numbers relate the hryvnia/dollar, as compared to 0.002 in euro/dollar, which is roughly 0.18% of the average value for the study period). Furthermore, it is a currency of a country with an unstable transition economy, which makes Ukraine less

attractive for investments. This is also one of the reasons for the relatively high rates of domestic government loans bonds in the country and the increased demand for them in particular.

The NBU plays an important role in the pricing of the hryvnia as it directly purchases or sells currency on the currency market to keep it within certain price limits to meet long-term and short-term government objectives. In addition, the NBU hinders currency volatility to a certain extent and is a kind of guarantee for investors due to its influence on currency fluctuations. Such NBU actions also increase the investment attractiveness of the country as it makes future investors' returns on Ukrainian securities more predictable, and thus, more favourable in their eyes. It is important to mention the Ukrainian currency market itself which, as already mentioned, is partly regulated and relatively small having on average about 400-500 million dollars traded per day [10].

Nevertheless, during the COVID-19 crisis, the Ukrainian currency started to strengthen. The main reason for this is the booming prices of some raw materials, which are the main export component of the country. A good harvest in 2020 and even better in 2021 (compared to 2020, in 2021 16.4% more wheat was harvested, 40% more barley, 35.5% more soybeans, etc) [11]. However, in 2021, due to the unstable political situation and the energy crisis caused by high energy prices in preparation for winter, the national currency could not gain as much strength as in 2020 and lost some ground. In addition to agricultural crops, steel, which is also an important export crop for the country, rose significantly in value. Figure 1 and 2 below show price charts for steel, wheat, and soybeans in dollars and growth percentages.

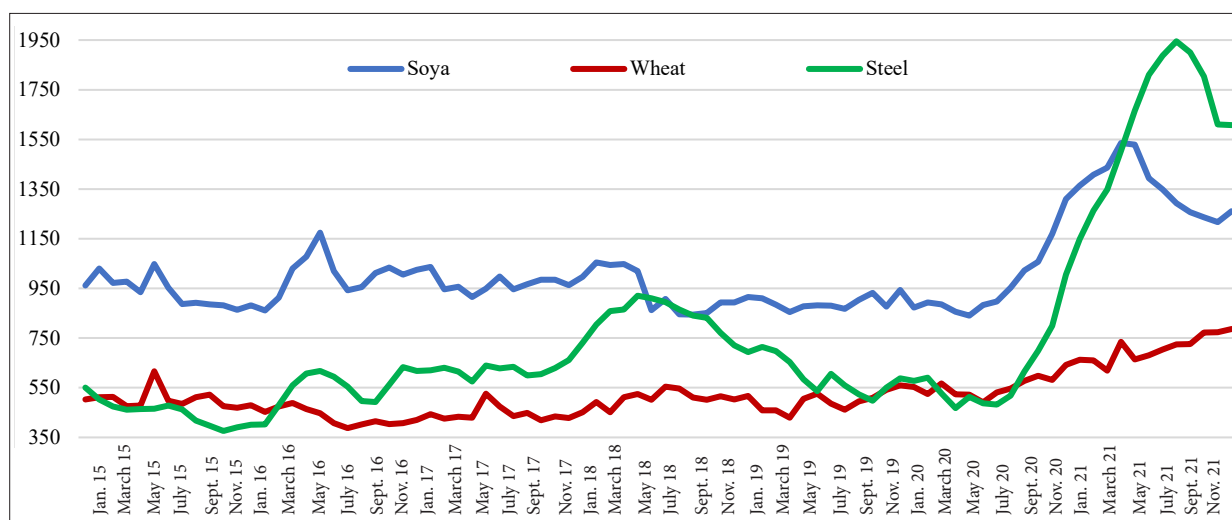


Figure 1. Coil steel, soybeans, and wheat prices from 2015 to 2021, USD

Source: compiled by the author based on data from [12]

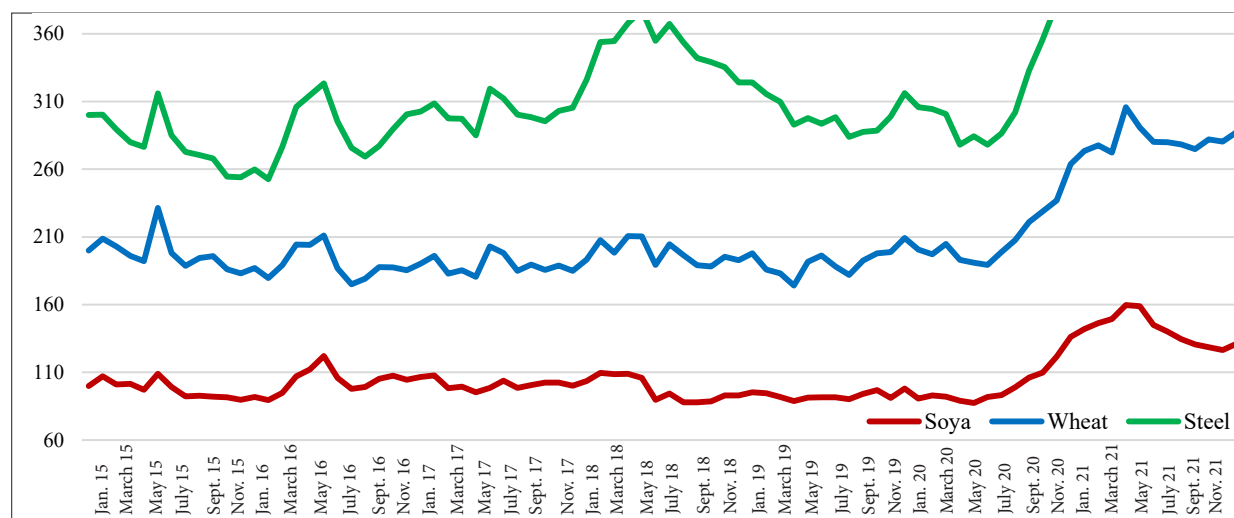


Figure 2. Coil steel, soybeans, and wheat prices from 2015 to 2021, %

Source: compiled by the author based on data from [12]

Such price increases (especially for steel, which amounted to almost 400%) could not help but affect the hryvnia. Overall, a significant strengthening of the hryvnia in 2020 can be observed. A non-linear relationship has been found between the price of commodities, and the hryvnia exchange rate using regression analysis, namely a hyperbolic relationship in which the function values were significant at a significance level of 0.05. Thus, the price of wheat should explain 8.3% of hryvnia-dollar exchange rate variation, soybeans – 10.6%, and for steel – 11.4%, although, in reality, those values could be lower if absolutely all factors affecting the exchange rate are taken into account. Nevertheless, the prices of Ukraine's main export crops have a clear and serious

impact on the currency. To begin with, in most developed markets, agents are aware of the presence of seasonality in the markets and try to get rid of this factor, smoothing the dynamics of exchange rates to get more clear and correct price signals [13]. Thus, the absence of seasonality is important primarily for macroeconomists, in order to better analyse the situation in the country. In general, seasonality is absent only in very efficient markets, but not always either. In Ukraine, however, the seasonality factor plays a certain role, which can be seen in the graph but can also be confirmed statistically. A graph of the hryvnia/dollar exchange rate from 2016 to November 2021 is shown below (Fig. 3).

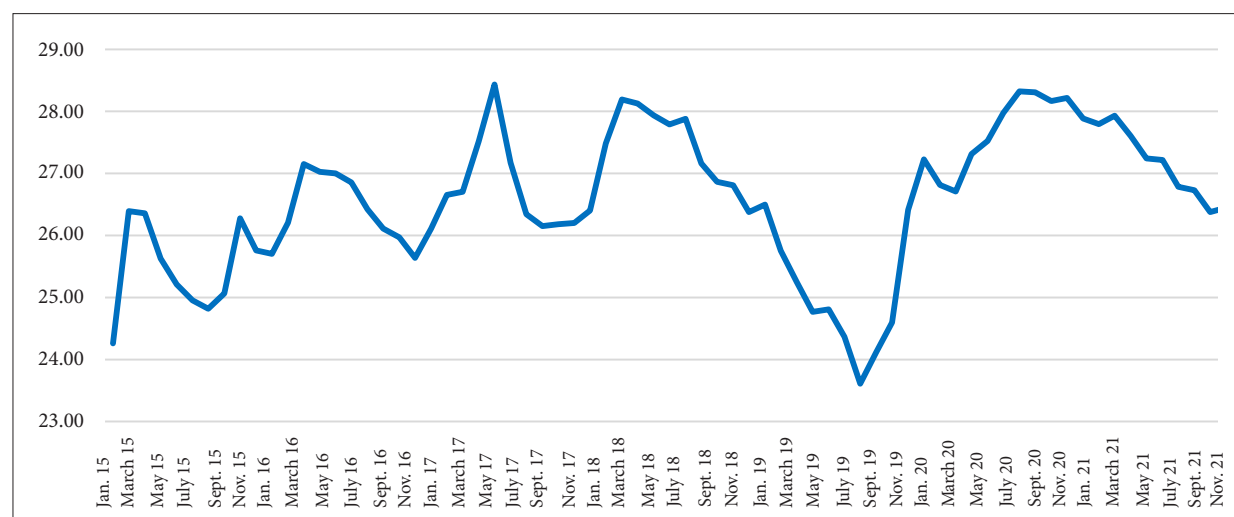


Figure 3. Hryvnia/dollar exchange rate from 2016 to November 2021

Source: compiled by the author based on data from [14]

Figure 3 shows that the hryvnia starts to weaken during winter, which is associated with the start of the heating season, and vice versa, it becomes stronger closer to spring and summer. However, in order to more accurately and clearly detect the seasonality of the hryvnia exchange rate, a time series model was built. The Adaptive model was

chosen, as it provides the best accuracy and the highest R^2 value, i.e., the model of the biggest significance. For this purpose, annual (12 months) moving averages and trend lines were drawn on the hryvnia graph. A graph with these additional lines describing the hryvnia-dollar exchange rate chart is demonstrated below (Fig. 4).

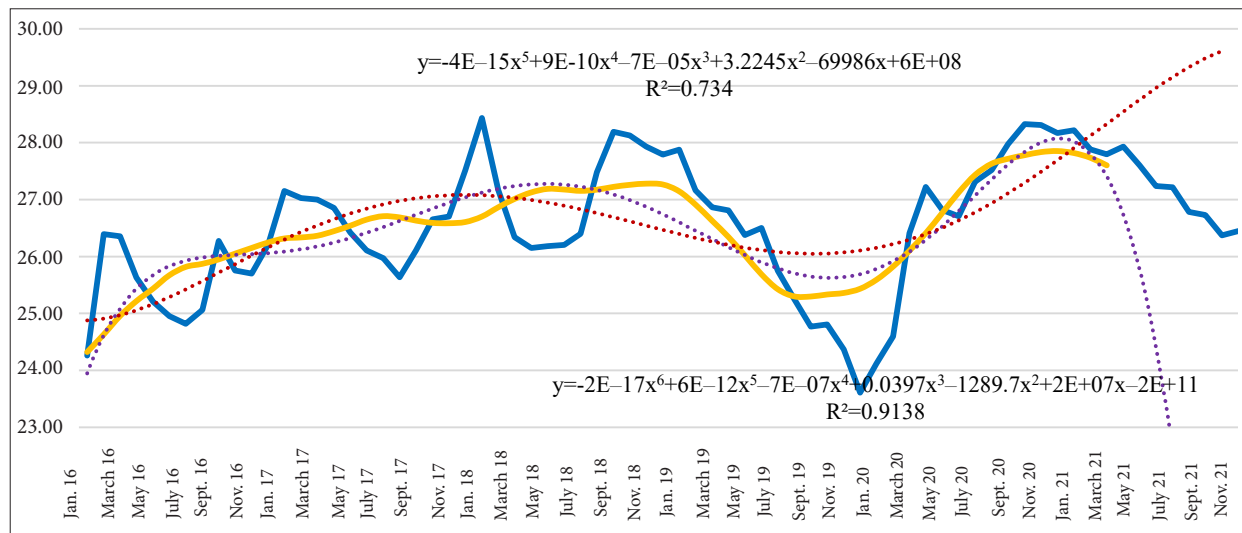


Figure 4. Trend lines and moving averages on the hryvnia-dollar exchange rate graph 2016-2021

Source: compiled by the author based on data from [14]

Two polynomial trend lines are marked on the graph: of the fifth and sixth-degree, but neither of them describes the possible future exchange rate of the hryvnia well enough. Although the polynomial curve of the sixth degree has an R^2 value above 0.91, its predicted values are difficult to believe, so it is obviously impossible to use only one seasonal indicator to predict the dollar exchange rate. Nevertheless, the following calculation will show that it does occur. The adaptive model has the form (1):

$$Y_t = T_t + S_t + E_t \quad (1)$$

In this formula Y_t is the final value, T_t is the trend value, S_t is the seasonality factor, E_t is the random factor. Since Y_t and T_t are known, $S_t + E_t$ can be found. To do this, the difference between the actual value of the exchange rate and the moving average for each of the selected months should be found, as well as the average value of these deviations. In fact, we get the value of $S_t + E_t$, but for simplicity, we can assume that the value of the random factor is 0, as from time to time it acquires positive and negative values respectively and levels out. Table 1 shows the calculating process of this indicator.

Table 1. Calculation of seasonality factor impact on the hryvnia-dollar exchange rate, UAH

Year	Month											
	Jan.	Feb.	March	Apr.	May	June	July	August	Sep.	Oct.	Nov.	Dec.
2016	0.21	2.07	1.73	0.67	-0.01	-0.48	-0.86	-0.75	0.40	-0.19	-0.35	0.05
2017	0.90	0.71	0.67	0.49	-0.02	-0.43	-0.68	-1.07	-0.58	0.02	0.11	0.93
2018	1.83	0.47	-0.52	-0.86	-0.95	-0.99	-0.78	0.33	1.02	0.90	0.67	0.51
2019	0.61	0.01	-0.05	0.18	0.04	0.48	0.06	-0.18	-0.53	-0.49	-0.97	-1.75
2020	-1.31	-1.00	0.59	1.12	0.40	-0.06	0.18	0.09	0.35	0.61	0.53	0.33
2021	0.37	0.07	0.06	0.33	x	x	x	x	x	x	x	x
Amount	2.60	2.33	2.47	1.93	-0.54	-1.00	-2.07	-1.59	0.66	0.85	0.00	0.08
S_t	0.43	0.39	0.41	0.32	-0.11	-0.30	-0.41	-0.32	0.13	0.17	0.00	0.02

Source: compiled by the author based on data from [14]

A positive S_t value indicates that the actual value in a given period is higher than the moving average, while a negative value indicates a correspondingly lower value of the actual exchange rate from the average. Table 1 demonstrates that the cold months – January, February, March, and April have positive S_t value steadily, while the warm months – May, June, July, and August have negative values. Although this model is not comprehensive and complex

enough to determine the exact values of the impact of the seasonality factor on the Ukrainian hryvnia, it shows that this factor does exist and affects the exchange rate of the hryvnia.

The same method was used to analyse the effect of seasonality on the hryvnia and the euro. Below are the graphs (Fig. 5, 6) of the hryvnia/euro exchange rate with and without averages and trend lines, respectively.

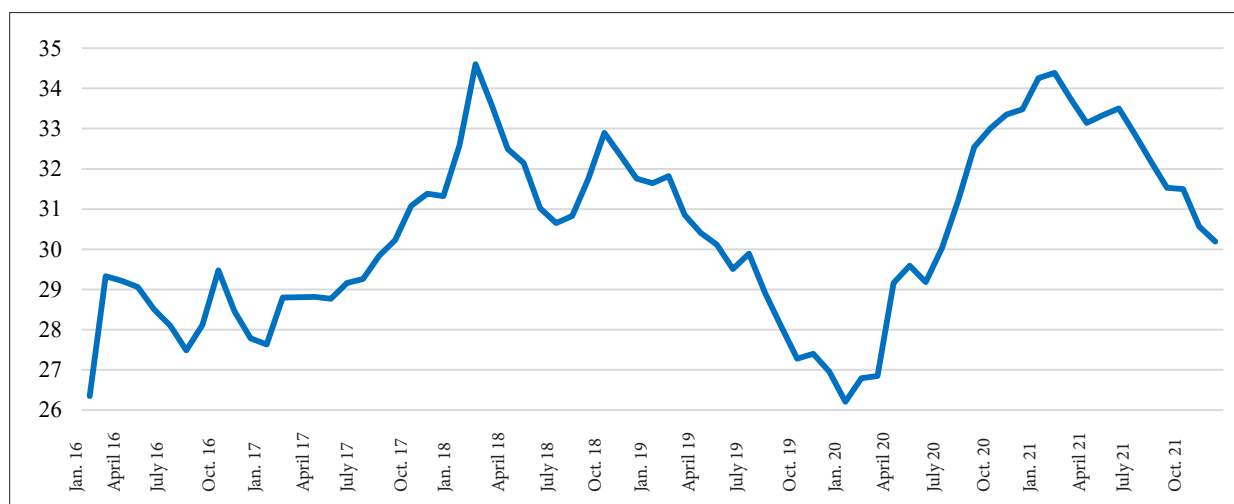


Figure 5. Hryvnia to the euro exchange rate from 2016 to October 2021

Source: compiled by the author based on data from [14]

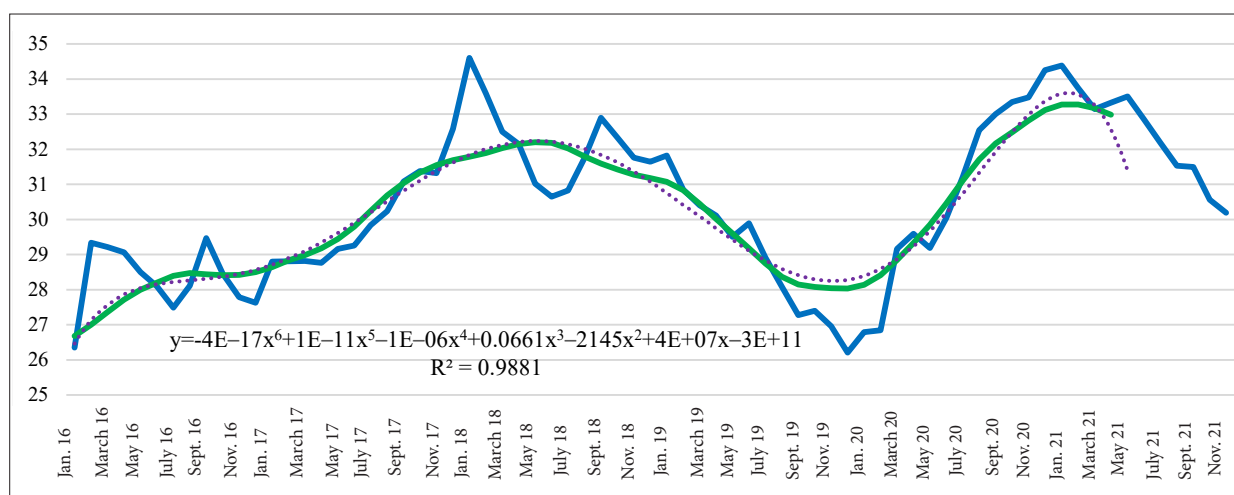


Figure 6. Trend lines and moving averages on the hryvnia/euro exchange rate graph for 2016-2021

Source: compiled by the author based on data from [14]

As can be seen, the trend line has also turned out to be polynomial to degree 6. Such lines best describe the movements of all hryvnia currency pairs over the study period. Figure 5 and Figure 6 included below show that the movements of the hryvnia-dollar exchange rate and the

hryvnia-euro exchange rate are quite similar externally (there is indeed a high correlation between them, 0.868). However, the movement of the euro to hryvnia is not difficult to model. Table 2 below also provides a calculation of the S_t values:

Table 2. Calculation of seasonality effects on the hryvnia exchange rate against the dollar

Year	Month											
	Jan.	Feb.	March	Apr.	May	June	July	August	Sep.	Oct.	Nov.	Dec.
2016	-0.33	2.33	1.85	1.34	0.51	-0.10	-0.90	-0.36	1.04	0.05	-0.64	-0.87
2017	0.16	-0.02	-0.17	-0.41	-0.28	-0.54	-0.41	-0.45	0.04	0.05	-0.23	0.89
2018	2.82	1.70	0.47	0.00	-1.18	-1.53	-1.20	-0.05	1.30	0.91	0.48	0.46
2019	0.75	0.01	-0.05	0.10	-0.10	0.71	0.17	-0.28	-0.87	-0.67	-1.08	-1.83
2020	-1.34	-1.57	0.32	0.27	-0.66	-0.41	0.11	0.83	0.84	0.87	0.66	1.14
2021	1.11	0.47	-0.03	0.34	x	x	x	x	x	x	x	x
Amount	3.16	2.93	2.40	1.65	-1.72	-1.87	-2.23	-0.31	2.35	1.20	-0.81	-0.20
S_t	0.53	0.49	0.40	0.27	-0.34	-0.37	-0.45	-0.06	0.47	0.24	-0.16	-0.04

Source: compiled by the author based on data from [14]

As we can see, a certain seasonality is observed in this currency pair as well. Figure 7, 8, and 9 included below

show the graphs of other currency pairs for the same period, namely yen/hryvnia, zloty/hryvnia as well as ruble/hryvnia:

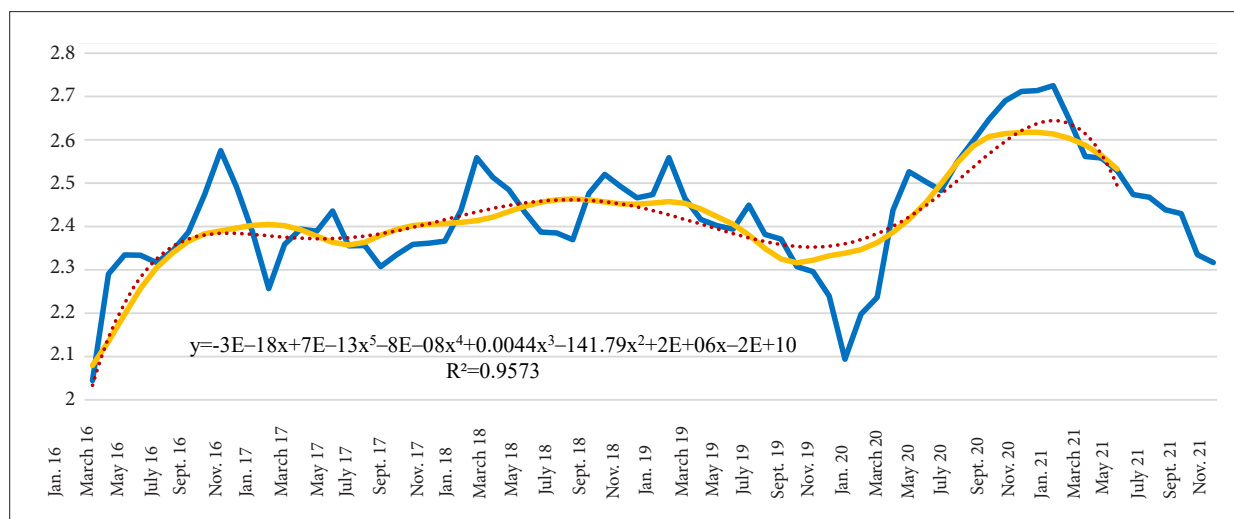


Figure 7. Trend lines and moving averages on the hryvnia/yen exchange rate graph in 2016-2021

Source: compiled by the author based on data from [14]

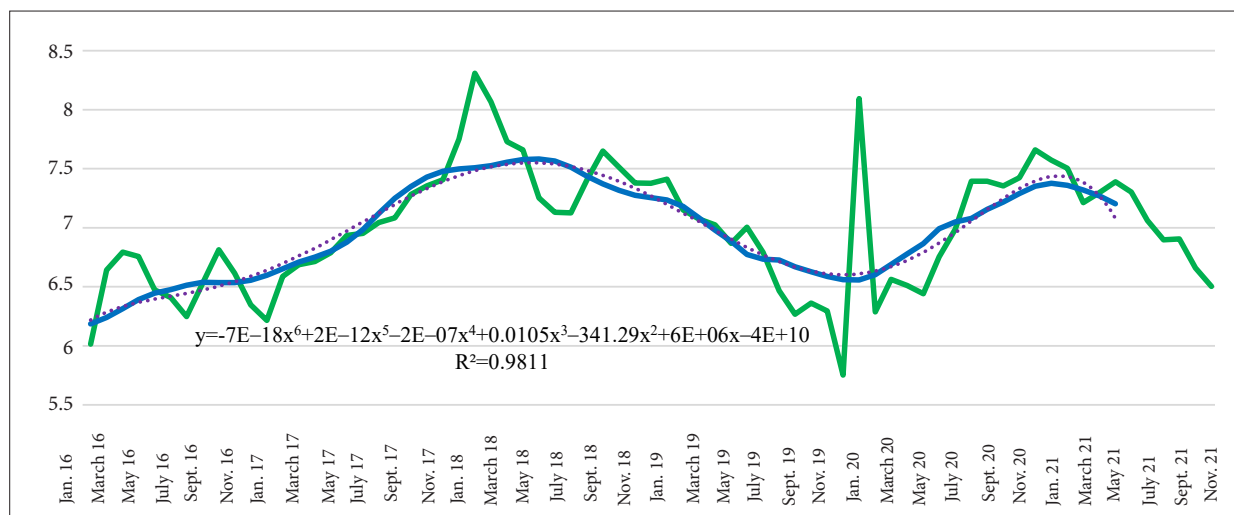


Figure 8. Trend lines and moving averages on the hryvnia/zloty exchange rate chart for 2016-2021

Source: compiled by the author based on data from [14]

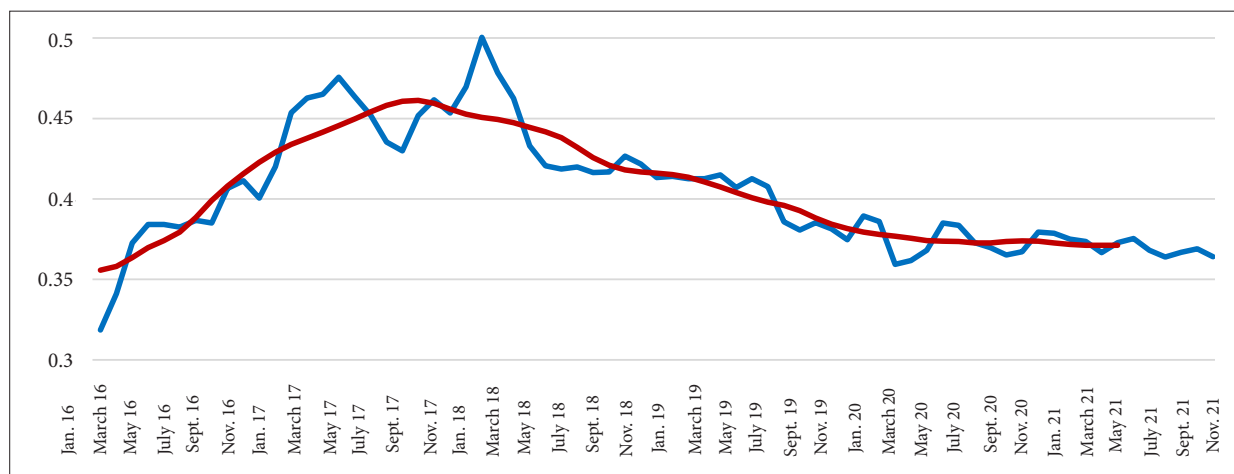


Figure 9. Trend lines and moving averages on the hryvnia/ruble exchange rate chart in 2016-2021

Source: compiled by the author based on data from [14]

A certain seasonality was found in all of these currency pairs, as shown in the following Table 3.

In order to estimate which of the currencies is affected by seasonality more, average seasonal deviations and their share to the average exchange rate were calculated. Thus, a value of 0.92% was obtained for the dollar, 1.08% for the euro, 0.77% for the yen, 1.58% for the zloty, and 1.33% for the ruble. Therefore, the most seasonally exposed pair is the zloty/hryvnia, which can be explained by seasonal currency

inflows from Ukrainian migrants in Poland. Moreover, we can notice that the two currencies most exposed to seasonality are relatively less developed countries and more open in terms of foreign trade (their export and import quotas are higher). Also, the charts show that the unstable exchange rate of the ruble is different from that of the other currencies. This is also confirmed by the correlation values between the currencies, which are provided in Table 4.

Table 3. Calculation of seasonality effects on hryvnia against yen, zloty, and rouble for 2016-2021 in nominal terms

Indicator	Month											
	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sen.	Oct.	Nov.	Dec.
S_t (yen)	0.022	0.029	0.033	0.036	-0.004	-0.005	-0.030	-0.003	0.025	0.004	-0.019	-0.059
S_t (zloty)	0.412	0.119	0.062	0.040	-0.083	-0.108	-0.140	-0.059	0.027	-0.028	-0.085	-0.119
S_t (ruble)	0.008	0.008	0.006	0.004	0.000	0.001	0.000	-0.016	-0.011	-0.003	-0.005	-0.003

Source: compiled by the author based on data from [14]

Table 4. Correlation between currency pairs in 2016-2021

	Yen	Zloty	Ruble	Dollar	Euro
Yen	1	0.578	-0.007	0.822	0.794
Zloty	0.578	1	0.404	0.655	0.818
Ruble	-0.007	0.404	1	0.166	0.130
Dollar	0.822	0.655	0.166	1	0.868
Euro	0.794	0.818	0.130	0.868	1

Source: compiled by the author based on data from [14]

Indeed, the hryvnia/dollar pair has the lowest correlation with the other currencies, mostly non-significant, which indicates the peculiarity and distinctiveness in the pricing of this currency pair. To assess the seasonality of the currency, it is important to cite the country's exports and imports, which have already been discussed above, as they largely determine the seasonality of the currency. It is important to note that Ukraine is, basically, a country with a negative foreign trade balance, which pushes the currency

to a gradual weakening in the long term. This has to do with the fact that Ukraine needs to borrow foreign currency to buy essential imports, as its currency is not an international one. Countries such as the USA, Japan, or EU countries do not borrow money to support their foreign trade because their currencies are freely tradable at currency markets, which is not the case with Ukraine. Figure 10 included below provides a graph of Ukraine's monthly exports and imports, as well as its trade deficit, for 2016-2020.

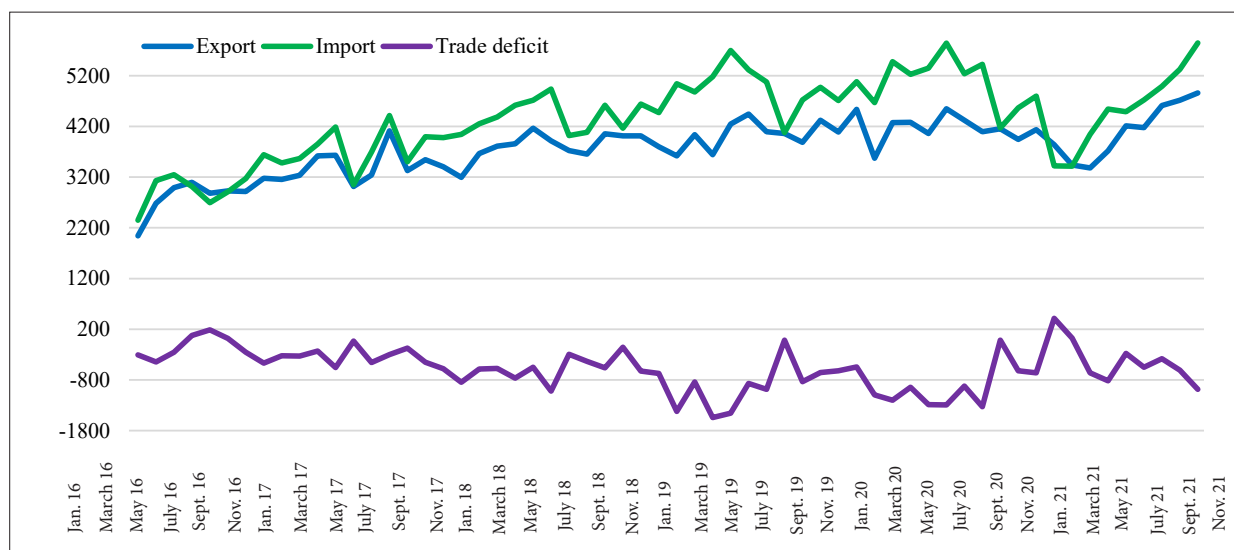


Figure 10. Ukraine's exports, imports, and trade deficit from 2016 to 2020, billion USD

Source: compiled by the author based on data from [15]

The seasonality of Ukraine's foreign trade is also shown in Table 5 below, which provides a breakdown of the calculated seasonality of exports, imports, and trade balance.

Table 5. Values calculations of seasonality effects on the hryvnia to dollar exchange rate

Indicator	Month											
	Jan.	Feb.	March	April	May	June	July	Aug.	Sen.	Oct.	Nov.	Dec.
S_t (export)	-262.17	-192.57	233.06	-34.17	-50.00	-340.53	-150.20	43.77	-13.33	194.01	292.02	164.08
S_t (import)	-654.27	-171.44	173.61	-495.57	-323.39	-314.16	80.90	109.78	199.97	519.14	319.55	372.14
S_t (balance)	392.11	-21.14	59.45	461.40	273.38	-26.37	-231.10	-66.01	-213.30	-325.14	-27.53	-208.06

Source: compiled by the author based on data from [15]

The Table 5 demonstrates that the seasonal values of the foreign trade balance are similar in their movements to the seasonal values of exchange rates. Indeed, there is an insignificant correlation between the values of seasonal deviation of foreign trade balance and the dollar exchange rate with a value of 0.37, for the yen – 0.48, for the zloty – 0.54, and the ruble – 0.5. This may be evidence of the influence of foreign trade balance on the rates of these currencies and be the main reason for its seasonality (the correlation value was too low for the euro).

Bonds and the currency exchange rate are theoretically linked, as when demand for government loans bonds increases, the national currency must strengthen. The reason

for this is that in order to buy government securities, non-residents must exchange currency for hryvnias. In other words, the more government sells its debt securities, the higher the demand for the currency is and the stronger it becomes. Conversely, exchange rate risk is a key determinant of sovereign bond yields [16]. Thus, currency exchange rate appreciation weakens the financial position of developing countries (including Ukraine) and increases bond rates [17]. However, when analysing the impact of domestic government loans bonds on the hryvnia, quite different results were obtained. Below there is a graph of monthly primary sales of domestic government loans bonds in the local currency from 2016 to 2021 (Fig. 11) and Table 6 with correlation values of demand for it.

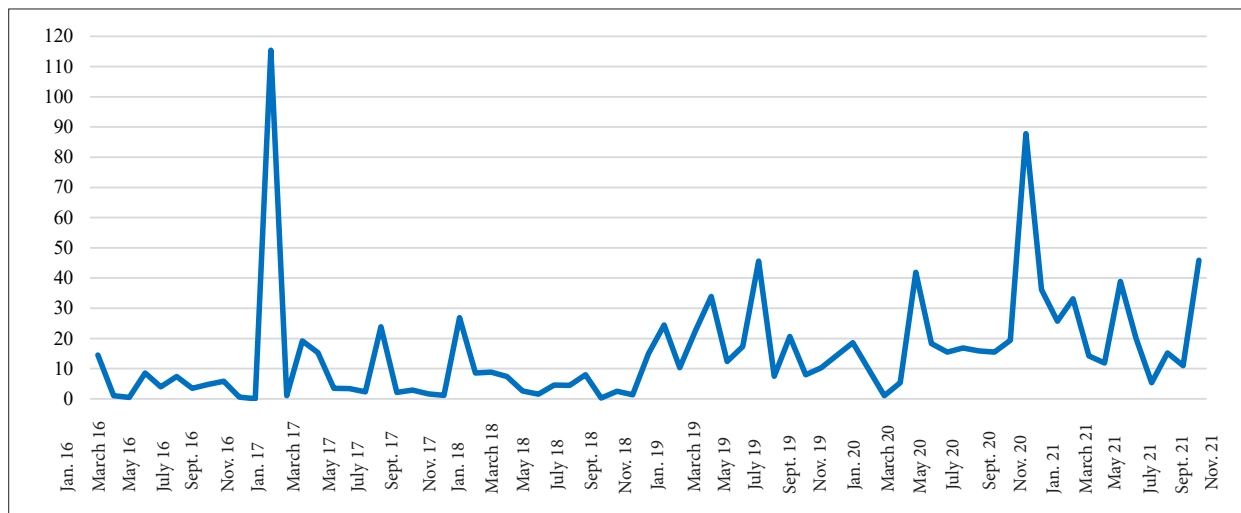


Figure 11. Primary sales amounts of domestic government loans bonds in Ukraine from 2016 to 2021, billion UAH

Source: compiled by the author based on data from [14]

Table 6. Correlation values of domestic government loans bonds demand and exchange rate

Year	Correlation value	
	Dollar	Euro
2016	0.212	-0.289
2017	0.346	0.152
2018	0.145	0.214
2019	0.307	0.314
2020	0.288	0.411
2021	0.167	0.101
2016-2021	0.164	0.106

Source: compiled by the author based on data from [14]

Therefore, according to Table 6, the correlation between the demand for domestic government loans bonds and the exchange rate was very low and positive, although, in theory, it should have been negative, since, as described above, an increase in demand for domestic government loans bonds should be supported by a strengthening of the currency. In addition, such correlation Graphs should not be taken into account and can be considered random. This was also confirmed by regression analysis, where R^2 values

were at or below 0.05 in all cases. The same results were obtained when analysing not only hryvnia-denominated domestic government loans bonds but also when analysing all government securities, including those in dollars and euros. Moreover, no significant correlation was found between bond rates and exchange rates. Figure 12 the Table 7 below, respectively, show the average monthly government bond rates from 2016 to 2021 and the correlation between the exchange rate and the domestic government loans bonds rates.

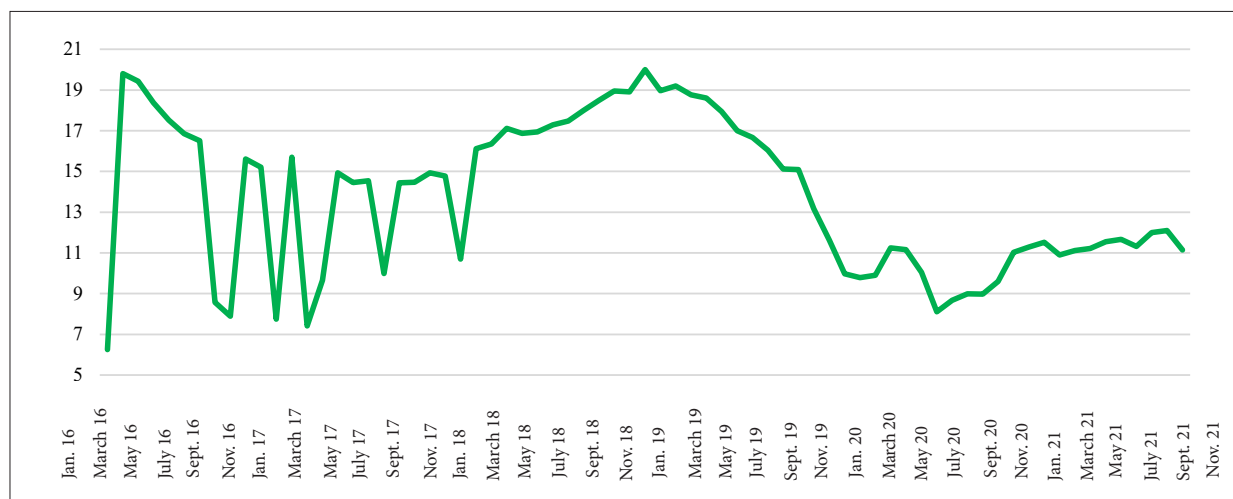


Figure 12. Government bonds rates from 2016 to 2021, %

Table 7. Correlation values of government bonds rates and exchange rates

Year	Correlation	
	Dollar	Euro
2016	0.246	-0.464
2017	-0.284	-0.666
2018	0.436	0.329
2019	0.962	0.252
2020	-0.155	0.401
2021	-0.534	-0.244
2016-2021	0.011	0.028

Source: author's devising

This suggests that the impact of the demand for government bonds on the exchange rate in the country has very little if any, impact. Most likely the reason for this is that the government itself chooses the number of government bonds it issues and increases the demand for them by increasing the interest rate (which is confirmed by the existing negative correlation of -0.35 between interest rates and sales of hryvnia securities). In this way, it issues more securities when there is a need to finance various projects and tasks. It is quite possible that at the time of the largest government bond issuance the exchange rate has already been appreciating and, as one of the measures to prevent this increase, the government raises the bond rates and issues a larger number of bonds. Thus, the effect of the bond issuance remains unnoticed or levels within a month, as

other factors, including political instability, play an excessive role in the country.

Therefore, the paper examined the influences on exchange rates of several factors, including seasonality, prices of the country's main export resources, and bonds demand. The study traced the presence of seasonality in all of the examined hryvnia exchange rates (in some it had more influence, in some less), which is consistent with the research of other authors, who also found the seasonality of the hryvnia [18]. Moreover, the seasonality factor is found not only in the exchange rate but also in the growth of GDP and other economic indicators [19]. All this points to the strong dependence of the Ukrainian economy on external seasonal factors and the low efficiency of the economy and markets. Thus, Ukraine needs to diversify its main export

crops, develop new industries that can become a part of Ukraine's global specialisation, and make it more resilient to the price of external resources.

The development of domestic bond markets is also important for the development of the state, which has been confirmed by the example of Latin American countries. They have thus been able to reduce dollar-denominated debt, reduce the factors that influence currency inefficiencies, and move towards longer maturities of domestic debt, lower interest rates, and refinancing risks [20-21]. The securities market, in general, is not very developed in Ukraine, especially the share market. However, both domestic and corporate bonds are mainly in demand by foreign investors looking for profits and some domestic ones. While other authors have been able to find some correlations between rates on government bonds and the exchange rate, this has not been achieved within the scope of this paper and using available research methods. This could also be due to the inefficiency of the Ukrainian economy or other reasons. In any case, the question of the impact of government bonds on exchange rates needs further consideration.

Conclusions

The article analysed exchange rates in Ukraine from different angles. The main researched factors were the demand for government bonds and seasonality. In the course of the study, it was found that there is a seasonality factor in all hryvnia currency pairs, which affects the exchange rate: in winter the hryvnia exchange rate is consistently above the

annual average curve, while in warmer periods it is lower. This is most likely due to the relatively low efficiency of the Ukrainian currency market, as this factor is absent (or almost absent) in more widely spread and traded pairs, such as euro/dollar. Seasonality is most pronounced in pairs of hryvnia with the ruble and zloty; the most likely reasons for this are that they are currencies of comparatively less developed countries than currencies of other comparable countries (US, Japan, and EU countries). It is also because foreign trade with these states has a more pronounced seasonal character: in the case of Russia, it is forced gas supplies, and with Poland, it is seasonal incomes of labour migrants.

In addition, other factors such as the price of certain resources were analysed. Wheat, steel, and soya were chosen for the analysis as they are among the major crops exported by the country. A significant hyperbolic regression relationship was found between the prices of these resources and the exchange rate, which empirically and statistically confirms the impact of these factors on the exchange rate. At the same time, when using this model, no similar evidence was found for the demand side of the country's government bonds, either from the analysis of government bond sales or from movements in interest rates. Possible theories for the absence of this relationship, which should exist from a theoretical point of view, have been described in the paper. It can be concluded that for Ukraine, the most important factors that influence the exchange rate are the successful trade policy of the government, which in turn depends to a large extent on resource prices.

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Аналіз динаміки курсів іноземної валюти в Україні з урахуванням факторів сезонності та попиту на облігації внутрішніх державних позик (понад 5–10 років)

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Анотація. Актуальність наукової статті полягає в обґрунтуванні важливості ролі валютних курсів для надійного функціонування економіки країни. Метою статті є аналіз динаміки курсів іноземної валюти, переважно долара та євро, в Україні з урахуванням факторів сезонності та попиту на державні облігації. Основними методами, використаними в роботі, є статистичні та емпіричні методи дослідження, зокрема моделювання. Визначено, що в Україні особливо важливу роль відіграє експорт сировини, переважно сталі, та різноманітних сільськогосподарських культур, таких як пшениця, кукурудза, соняшникова олія, соя тощо. З'ясовано, що зазначені коливання експорту є однією з причин сезонності валюти, але не єдиною чи основною причиною. Оскільки на обмінний курс сильно впливають ціни на нафту, газ та інші енергоносії, які потребуються постійно, особливо в опалювальний сезон. Також проаналізовано курс гривні за останні п'ять років у контексті Національного банку України. Виявлено, що попит на облігації державних позик є одним із найважливіших факторів при врахуванні курсів іноземних валют в Україні. Щоб зробити моделі більш правдоподібними та зменшити вплив інших факторів на визначення сезонності валюти з певними валютними парами: з долларом, євро, йеною, злотим та рублем, використано дані за останні кілька років, які є меншими хибними під впливом зовнішніх факторів. Підтверджено, що успішна торговельна політика є ключовим джерелом валютної стабілізації в Україні. Стаття корисна для вивчення функціонування валют загалом; для вивчення економіки України, особливо валютного питання країни; для студентів різних економічних дисциплін

Ключові слова: економіка України, курси валют, сезонність, ринок облігацій, фінанси

**Рецензія на монографію С.І. Страпчук
«Сталий розвиток аграрних підприємств на засадах
циркулярної економіки»**

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**Review of the Monograph of S.I. Strapchuk
“Sustainable Development of Agricultural Enterprises on the principles
of a Circular Economy”**

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A comprehensive approach to the management of agricultural enterprises requires integrating various interactions of environmental constraints, social needs, and economic efficiency of operations. The economic dimension of sustainability is of particular importance, as it represents a flexible and dynamic system where people and economic relationships are key in achieving sustainable development goals (SDGs).

The peer-reviewed monograph deserves the attention of scholars, managers, and authorities since it reveals the concept of sustainable development of agricultural enterprises on the principles of a circular economy.

The five-part book includes a theoretical background

and methodological approaches to sustainable development in agriculture; a monitoring of the progress of Ukraine with the achieving SDGs. The existing business models of agricultural enterprises in the EU were also considered based on the principles of a circular economy. The new measurements and the mechanism for sustainable development of socio-economic systems were developed based on a circular economy.

The first section explores the theory of sustainable development by examining the evolution of concepts and defining the role of the UN in implementing the ideas of sustainability, comparing the constraints, barriers, and indicators for measuring a circular economy in conjunction

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with the principles of sustainable development. An important part of the section is the study of the specifics of sustainable development in agriculture and its legal framework, which support it.

The second section of the book covers different methodological approaches and measurements of sustainable development of agricultural enterprises, as well as the circular economy. The research contains a survey based on questionnaire, which suggests definitions, barriers, and consequences of sustainable development for agricultural producers. The monitoring of the level of sustainability requires designing the integrated indices, modelling scenarios using a set of econometric equations, and defining specified targets. A benchmarking study of adapting business models to the circular economy by European Union agricultural enterprises is also an important part of the monography.

The monitoring of sustainable development level, presented in the third section, covers four key dimensions – economic, environmental, social, and energy. The author points out that despite the emphasis on the energy component, the sustainable development goals are considered in the context of three-pillar concept, which is the basis for measuring the integrated indices of sustainable development of agricultural enterprises in Ukraine in 2015-2019.

The fourth section suggests the structure of inter-sectoral balances in 2003-2019, which reflect the decline in the level of self-sufficiency (circularity) of the agricultural sector. The author proposes the measurement of ecological

and economic diversification of agrarian enterprise with an appropriate coefficient based on the principles of sustainable development, which allows considering the level of diversity of cultivated crops in conjunction with the structure of marketable products. The research investigates the factors of sustainable intensification of agrarian enterprises in Ukraine and Kharkiv region based on correlation-regression models, and supports the theoretical assumptions about the influence of the factors (crop diversity, use of organic fertilisers, livestock in the farm, labour costs, and mineral fertilisers) on the crop yield of agrarian enterprises.

The last section of the monograph substantiates the mechanism for the design of an appropriate institutional environment. The key steps are the adoption of sustainable development strategies for agricultural enterprises based on sustainable intensification factors; the development of a sustainable development mechanism, and case studies of business models for agricultural enterprises based on the principles of a circular economy.

The monograph is a thorough study that deals with the issues of sustainable development and circular economy in the agricultural sector, accompanied by the interdisciplinarity of the research and a comprehensive approach. The scientific work deserves a positive assessment, as its author managed to consider the conceptual principles, barriers, and consequences of sustainable development based on the circular economy, which could be priorities for the development of the agricultural sector.

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**НАУКОВИЙ ВІСНИК
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