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Editors office address:
Simon Kuznets Kharkiv National University of Economics
61166, 1-A Inzhenerny Ln., Kharkiv, Ukraine
E-mail: info@devma.com.ua
www: https://devma.com.ua/en

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A Nonlinear Mathematical Model of Dynamics of Production and Economic Objects

Anatoly Voronin*, Irina Lebedeva, Stepan Lebedev

Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine

Abstract. A person who makes decisions regarding the management of an industrial and economic object feels the need for tools to solve numerous problems that arise in the process of functioning of this object as an economic system in the conditions of interaction with the environment. The purpose of this work is to build an analytical model of the production and economic system, which would allow studying the structural changes that may occur in the process of functioning of economic objects with a closed cycle of production activity and which determine the possible ways of evolution of an open economic system over time (phase trajectories of evolution). The methodology of nonlinear dynamics and economic synergy was used to create the model. The work proposes a mathematical model of the production and economic system with a small number of phase variables that have a market interpretation, and determines endogenous and exogenous parameters that characterize the state of the system and the direction of its development. The model contains a system of two ordinary differential equations with quadratic nonlinearity. This formalization made it possible to obtain general information about the development trajectories of this system and its stationary states with the identification of the most significant critical modes of functioning. Qualitative analysis based on this model showed that non-linearity leads to non-unity of equilibrium states and the existence of both stable and unstable development trajectories of the economic system under study. This model can be used to manage any complete economic unit in which an independent closed cycle of reproduction is ensured

Keywords: economic dynamics, mathematical model in continuous time, nonlinear dynamics, synergism, phase trajectories of evolution, stability of equilibrium points, bifurcation

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INTRODUCTION

The paradigm shift that took place in economic theory during the last decades led to the formation of such a scientific methodology as economic synergy. To replace the concept of linearity of dynamic processes, there is an awareness of the need to take into account nonlinear effects associated with the existence of real large feedback systems, as well as the presence of critical levels of parameter values characterizing the state of the system. The effect of nonlinearity is manifested in the fact that instead of a single solution that would uniquely determine the development of the system over time in accordance with the initial conditions, a whole spectrum of solutions appears. It is expedient to consider a modern enterprise as a complex production and economic system, which is characterized by non-linear interaction of processes that determine the state of this system. When developing a mathematical model of a production and economic system, attention should be paid to such system properties. First of all, it is manifested in a large number of various structural elements that are interconnected and constantly interact with each other. In turn, each of these structural elements is also a complex system. These structural elements have a different nature and can be considered as separate open systems. That is, a complex system (industry, holding, enterprise) can be provided as a set of subsystems. At the same time, the purpose of functioning of each of the subsystems is subordinated to the purpose of functioning of the system as a whole. It is this set of structural components in their interaction that determines the behavior of the system, which is manifested in a series of changes in its states (development trajectories) over time.

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*Corresponding author

The interaction of some structural elements of the system can be additive (in this case, the system is linear), but for the system as a whole, a synergistic effect is observed (this is a manifestation of nonlinearity). In addition, complex dynamic systems are open, that is, the functioning of the system occurs in the interaction of its structural elements not only among themselves, but also with the external environment. It is under the influence of the external environment and internal processes caused by this influence that the system transitions from one state to another, that is, quantitative changes in the parameters characterizing the state of the system are observed. Another complication is that, in general, the production and economic system is under the influence of random factors, so the functioning of any production has a probabilistic nature. It should also be noted that in such complex systems there may be feedback loops, that is, there may be chains of cause-and-effect relationships, according to which the output data partially returns back as input data. It follows from this that the person who makes a decision regarding the management of the development of the production and economic system should do so on the basis of a thorough analysis of the possible trajectories of the system's development and the determination of the factors influencing the direction of this development. Such opportunities are provided by mathematical modeling, which is one of the most effective research methods. In this sense, mathematical modeling is a universal tool for carrying out qualitative analysis (analysis of possible trajectories of system development), which allows predicting the system's behavior over time. The need to take into account a large number of variable factors and parameters when building a mathematical model of the production and economic system leads to an increase in the dimensionality of the model. This significantly complicates the quantitative verification of possible scenarios of the development of production and economic systems and its possible equilibrium states, even despite the high development of computer technology.

Therefore, when creating a mathematical model of the production and economic system, it is necessary to limit the number of endogenous parameters, leaving only those of them that most significantly affect the development of the system, as well as to highlight the most general so-called order parameters that reflect the interaction of the system with the external environment. This approach makes it possible to analyze the potential trajectories of system development and to determine the leading factors of influence, the management of which makes it possible to realize the equilibrium states of the system or to direct the development of the system along the selected trajectory.

The purpose of this work is to create an analytical model that would allow research into possible trajectories of the evolution of the production and economic system based on the methodology of nonlinear dynamics and economic synergy. The approach to creating a mathematical model of the dynamics of the production and economic system, proposed by the authors, combines the solution of this problem with the help of technical and economic analysis and qualitative forecasting (according to phase trajectories).

LITERATURE REVIEW

Within the paradigm of linear economy, production systems are considered as systems whose purpose is to meet the needs of consumers, and their structure is determined by the dependence on available resources and demand for products. Accordingly, the operation of such a system is determined by the principle of "take – do – throw". In contrast to this systems thinking, which is inherent in the economics of complex dynamical systems, allows us to study the structure of such systems, asking "what if" about the potential behavior of the system, thereby improving understanding of causal behavior and its transition to a state that previously seemed paradoxical [1].

If system thinking is a way of describing and understanding cause-and-effect relationships within the system, then system dynamics as a research method is the construction of a mathematical model, which in its final implementation gives a qualitative idea of the result of the interaction of these relationships. A problem-oriented approach to modeling (creating models of system dynamics) was proposed by Jay Forrester in the late 1950s. His research was aimed at helping corporate managers to better understand production problems, so the principles of nonlinear system dynamics became an approach to the development of corporate policy [2]. If traditional research methods suggest solving a complex problem by breaking it down into separate components and examining each of them separately, then system dynamics is based on the idea that problems exist precisely because of the interaction of the structural components of the system. The peculiarity of this interaction is that it gives a synergistic effect. This can lead to the formation of feedback loops, information lag within the system, etc. At the current stages of the development of economic science, it is the system dynamics that is the basis of the choice of methods for finding solutions to such problems. This approach has found its application in various scientific fields. Examples of its use include modeling processes responsible for improving the health care system [3], when solving sociological problems [4; 5], studying the processes that determine the development of micro- and macroeconomics [6-8], solving complex problems of regional development [9-11], for building models of performant development [12], etc. This approach is the basis of a new direction in analytical economics, which was named synergistic economics [13]. Within the framework of this direction, special aspects of the nonlinearity of the development of complex systems are considered. These include bifurcations, hysteresis, as well as chaos (catastrophe), when small changes in system parameters can lead to different results, or cases when the development of the system leads to the formation of an increasing number of structural patterns [14; 15]. During economic analysis, sudden structural changes, the presence of regular and irregular fluctuations, the role of random factors in economic evolution, as well as the influence of time scales and rates of adjustment of economic variables on the processes of system development are of particular interest.

The concept of "synergy", as well as the mathematical apparatus used to model such systems, came to economics from physics back in the 60s and 70s of the

20th century. This is due to the fact that studies of open economic systems revealed a violation of additivity when moving from the analysis of the activity of individual elements of the system to the determination of the characteristics of the entire system as a whole. That is, the total effect of the interaction of the structural components of a complex system (its subsystems) significantly exceeds the effect of simply adding the corresponding characteristics of each of the components, if they develop autonomously, without interacting with each other. Such complex systems are defined as nonlinear. For non-linear time series, the use of traditional econometric analysis is impossible. In this case, the theoretical foundations of economic synergy are used as a scientific methodology, which studies the self-organization of developing systems, when this development is based on multiplicative processes. Therefore, the most important thing in the study of such systems is the so-called qualitative forecasting, that is, the analysis of the hierarchy of stable and unstable trajectories with the classification of special points (equilibrium positions). At the same time, the exact value of the parameters of the economic system is not mandatories; it is enough that they are comparable.

In mathematical modeling, system dynamics is considered as an approach that allows describing the structure of complex systems, taking into account material and informational feedback loops. This makes it possible to investigate the causes and consequences that cause turbulence in development trajectories, and to develop highly effective management solutions aimed at increasing the productivity of the entire system as a whole [16]. Schematically, the modeling process can be represented as a sequence of such stages (Fig. 1).

Figure 1. Stages of creating a system dynamics model

Source: developed by the authors based on research [16]

Creating models of economic dynamics consists of two generalized stages: qualitative and quantitative [17]. Initially, the problem must be formulated in terms of the choice of research topic, key variables, time horizon, and the history of behavior of key concepts and variables. Then a working hypothesis is formulated to reflect an understanding of how the researcher perceives the key causal mechanisms that give rise to the problem. This is a qualitative stage of building a dynamic system model. It is now possible to proceed to the quantitative stage, in which a simulation model is developed to test the ability of the dynamic hypothesis to determine answers to key questions about the functioning of the system. Finally, the verified dynamic model is used to develop a control influence that will determine the development of the system along the selected trajectory.

Forrester's key idea, which is the basis of the modeling of economic systems of dynamics, was that a mathematical model of any complex system can be created using only two types of variables: stocks and flows [2]. Stocks can only be changed through their associated inputs and outputs. Flow regulation, in turn, is carried out using functions that act similarly to valves located at the inlet and outlet. Due to the presence of closed loops and time lags in such systems, elements of nonlinearity behavior arise. As a result, such development trajectories appear that are absent in linear systems. Examples of trajectories that are inherent only to nonlinear systems can be sub- and superharmonic phenomena, synchronization, bifurcations (as a result of which significant jumps in development occur), hysteresis (ambiguous dependence of changes in the state of the system on changes in external factors), and chaos (when small changes in the initial conditions can lead to completely different results). The most interesting in this regard is the self-organization of the system, that is, the formation of a new ordered structure as a result of the evolutionary and adaptation processes taking place in the system.

The description of the evolution of the states of a complex system within the framework of nonlinear dynamics requires the use of a certain formal apparatus. As a rule, system of differential equations is used for this, if the studied process is continuous in time. Or, if time is considered discrete, system of equations in finite differences is used. The main complication that arises in the study of nonlinear systems is that the principle of superposition (which assumes the additivity of the effects of various factors) does not apply to such systems. It should be noted that this principle allows for any linear problem to separate the linear equations describing the system evolution, and this cannot be done for a nonlinear system. To overcome this shortcoming, several methods have been proposed in recent decades for finding the solution of a system of differential equations describing the state of nonlinear systems. The toolkit for development of mathematical models of nonlinear dynamic systems and means of their analysis are becoming more and more important for solving real problems not only in technical sciences, but also in sociology, economics [14; 15], biology etc.

MATERIALS AND METHODS

In this study, when creating a mathematical model of a complex production and economic system, time is considered as a system-forming factor. The analysis of the evolution of such a system consists in the fact that its development is considered as a movement in phase space along a certain phase trajectory, that is, the analysis carried out is qualitative. The task of such an analysis is to study how the qualitative restructuring of topological structure of the system takes place when parameters of system are changed. When developing a mathematical model of the production and economic system, it is necessary to limit the number of endogenous parameters by determining the most common of them (the so-called order parameters), which reflect the interaction of the system with its external environment under the influence of various exogenous factors.

To determine the state of the dynamic system, it is necessary to take into account the following elements [18]. First of all, it is the metric space U which is defined as a phase space. Secondly, it is a variable t that characterizes time. In this paper, time is considered continuous, i.e. $t \in R^1$. It should be emphasized that such a mathematical model determines the evolution of the dynamic system in real time, that is, it describes a dynamic system which is continuous in time. Thirdly, it is the law of evolution, that is, a function that for any point of the phase space U and any value of t uniquely reflects the state of the system $\varphi(t, X) \in U$. This function has the following properties:

$$\varphi(0,\ X) = X;$$
$$\varphi\big(t_1,\ \varphi(t_2,\ X)\big) = \varphi(t_1 + t_2,\ X),$$

where the function $\varphi(t, X)$ is continuous in its arguments (X, t).

To determine the phase trajectories, along which the evolution of the system is carried out, the tools of differential calculus were used. The evolving system can be mathematically described by a system of differential equations, which in standard form look like this:

$$\frac{dX}{dt} = \dot{X} = \varphi(t,\ X). \tag{1}$$

In the problem considered in this study, the vector X has two components (unit price and demand volume), i.e. $X = X(t) \in R^2$, and the function $\varphi(X, t)$ is a sufficiently smooth function defined by to some subset $U \subseteq R^2 \times R$.

Since the production and economic system is dissipative, integration was not used, but a qualitative analysis of the system of differential equations (analysis by phase trajectories) was carried out. Their stability was considered one of the main issues that were paid attention to during the study of the properties of possible development trajectories.

RESULTS

The production and economic system can use its profit for the needs of production development and for non-production accumulations:

$$E = I + S, \tag{2}$$

where E is the amount of profit; I is volume of investment in production; S is savings.

Savings are made for the purpose of further use of financial resources for the formation of a reserve fund, conducting scientific research, research and development works, etc. Thus, savings related to the factors contributing to changes in the structure of production and, accordingly, the trajectory of the development of the production and economic system [19]. Therefore, since part of the profit from the activity of the production and economic system is invested in production, that is, the output data is partially transferred to the input, feedback is realized in the system.

Suppose that the growth of demand for production products is determined by a linear decreasing function:

$$D = d_0 - a \cdot p, \tag{3}$$

where $D = D(p)$ is the market demand function; $p = p(t)$ is the price of a unit of production; d_0 and a are the corresponding parameters of the demand function.

Let's assume that the volume of products produced during the studied period is sold on the markets without the formation of stocks. In this case, the price regulation mechanism is determined by the difference between the demand and supply of products:

$$\frac{dp}{dt} = \beta\left(b - \frac{y}{a} - p\right), \tag{4}$$

where the parameter b is determined by the correlation $b = \frac{d_0}{a}$; $y = y(t)$ is a function that describes the amount of supply at the relevant time; β is the coefficient of market adaptation.

Profit from sold products can be described by the formula:

$$E = (p - c)y - c_0, \tag{5}$$

where c is conditional variable costs; c_0 is conditionally constant costs.

We will assume that the amount of savings grows in proportion to the amount of profit:

$$S = sE,\ 0 \le s \le 1, \tag{6}$$

where s is the savings multiplier.

According to equations (2) and (6), we have:

$$I = (1 - s)E. \tag{7}$$

The increase in the volume of production is carried out at the expense of the investment component of profit:

$$y = \gamma I,\ \gamma > 0,$$

or

$$\frac{dy}{dt} = \alpha \cdot ((p - c) \cdot y - c_0), \tag{8}$$

where $\alpha = \gamma \cdot (1\text{-}s)$ is the marginal cost of increasing output.

Differential equations (4) and (8) completely determine the dynamics of the production and economic system, where the volume of production and the price of a unit of production appear as order parameters:

$$\begin{cases} \frac{dy}{dt} = \alpha((p - c)y - c_0); \\ \frac{dp}{dt} = \beta\left(b - \frac{y}{a} - p\right). \end{cases} \tag{9}$$

Such a system of two ordinary differential equations has special solutions that satisfy the algebraic equation:

$$\begin{cases} p^2 - (b - c)p + bc + \frac{c_0}{a} = 0; \\ y = a(b - p). \end{cases} \tag{10}$$

It follows from system (10) that the condition for the existence of two special solutions is the fulfillment of the inequalities:

$$\begin{cases} b - c > 0; \\ a\left(\frac{b-c}{2}\right)^2 > c_0. \end{cases} \tag{11}$$

And the coordinates of special points corresponding to the equilibrium state of system (9) are calculated using the following formulas:

$$p^*_{1,2} = \frac{b+c}{2} \pm \sqrt{\left(\frac{b-c}{2}\right)^2 - \frac{c_0}{a}}, \quad p^*_1 < p^*_2$$
$$y^*_{1,2} = a\left(\frac{b-c}{2} \mp \sqrt{\left(\frac{b-c}{2}\right)^2 - \frac{c_0}{a}}\right), \quad y^*_1 > y^*_2$$

It is convenient to study the properties of system (9) using deviations from the equilibrium values p^* and y^*, and also in the new time scale $t_0 = \alpha \cdot t$. Then this system takes the form:

$$\begin{cases} \frac{d\tilde{y}}{dt} = (p^* - c)\tilde{y} + a(b - p^*)\tilde{p} + \tilde{y} \cdot \tilde{p}; \\ \frac{d\tilde{p}}{dt} = -\frac{\xi}{a}\tilde{y} - \xi\tilde{p}, \end{cases} \quad (12)$$

where $\tilde{p} = p - p^*$, $\tilde{y} = y - y^*$ and $\xi = \frac{\beta}{\alpha}$.

The matrix of the linear part of the system (12) has the structure:

$$\mathbf{A} = \begin{pmatrix} p^* - c & a(b - p^*) \\ -\frac{\xi}{a} & -\xi \end{pmatrix}.$$

This matrix has a characteristic polynomial:

$$\lambda^2 - \mathrm{tr}\mathbf{A} \cdot \lambda + \det \mathbf{A} = 0, \quad (13)$$

where $\mathrm{tr}\mathbf{A} = p^* - c - \xi$ is the trace of the matrix $\mathbf{A}$; $\det \mathbf{A} = \xi(b + c - 2p^*)$ is the determinant of the matrix $\mathbf{A}$.

Thanks to the consideration of the characteristic equation (13), we obtain the stability conditions of the equilibrium position of the system (12), which can be given in the form:

$$\begin{cases} p^* - c - \xi < 0; \\ b + c - 2p^* > 0. \end{cases} \quad (14)$$

For the lowest equilibrium unit price p_1^*, which is the first of the inequalities of system (14), gives the relation:

$$\xi > \frac{b-c}{2} - \sqrt{\left(\frac{b-c}{2}\right)^2 - \frac{c_0}{a}},$$

and the second inequality of system (14) is fulfilled automatically.

For a special point p_2^*, which is greater than p_1^*, the inequality $b - c < 2p_2^*$ always holds. Therefore, this state of equilibrium is unstable for any ratio of system parameters (12). And the observed instability is saddle.

The analysis of the mathematical expressions for the trace and the determinant of the matrix of the system (12) showed that for each of them, independently of each other, a change of sign is possible. Therefore, let us assume that the trace tr**A** and the determinant det**A** of this matrix are small sign variables, i.e.

$$\begin{aligned} c + \xi - p^* &= \mu_2, \\ \xi(b + c - 2p^*) &= \mu_1, \end{aligned} \quad (15)$$

where μ_1 and μ_2 are small parameters.

With the help of relations (10), we exclude the coordinate of the equilibrium price p^* from the expressions (15) and obtain the connection equation for determining the bifurcation parameters of the system (12):

$$\begin{aligned} c_0 &= a(\xi - \mu_2)\left(\xi - \mu_2 + \frac{\mu_1}{\xi}\right), \\ b - c &= 2(\xi - \mu_2) + \frac{\mu_1}{\xi}. \end{aligned} \quad (16)$$

Taking into account the obtained ratios (16), system (12) takes the form:

$$\begin{cases} \frac{d\tilde{y}}{dt} = (\xi - \mu_2)\tilde{y} + a\left(\xi - \mu_2 + \frac{\mu_1}{\xi}\right)\tilde{p} + \tilde{y} \cdot \tilde{p}; \\ \frac{d\tilde{p}}{dt} = -\frac{\xi}{a}\tilde{y} - \xi\tilde{p}, \end{cases} \quad (17)$$

and, accordingly, we will have the characteristic equation (13) in the form:

$$\lambda^2 + \mu_2\lambda + \mu_1 = 0. \quad (18)$$

When $\mu_1 = \mu_2 = 0$, the solution of equation (18) is twice zero, so it can be assumed that in the nonlinear system of differential equations (17) the so-called Bogdanov-Takens bifurcation may arise, for which it is necessary to carry out a variation of two parameters [20; 21]. Such a bifurcation can occur if the linearization of the function around a stationary point has a double eigenvalue at zero. It should be noted that knowing the location of the bifurcation points and the type of bifurcation that is realized at this point is of great importance, as it marks the transition from one dynamic mode to another.

For a detailed study of the properties of the bifurcation of the "double zero", i.e. Bogdanov-Takens bifurcations, it is necessary to present the system (17) as the corresponding normal form. For this purpose, we will introduce new variables. Let $\tilde{y} = -\xi x_1 - x_2$ and $\tilde{p} = \frac{\xi}{a}x_1$. Then, after algebraic transformations, this system can be written in the form:

$$\begin{cases} \frac{dx_1}{dt} = x_2; \\ \frac{dx_2}{dt} = -\mu_1 x_1 - \mu_2 x_2 + \frac{\xi^2}{a}x_1^2 + \frac{\xi}{a}x_1 x_2. \end{cases} \quad (19)$$

Let's make another substitution of variables:

$$x_1 = a\left(y_1 + \frac{\mu_1}{2\xi^2}\right), \quad x_2 = a\xi y_2.$$

With the help of the new time scale , we obtain the desired normal form for the system of differential equations (17):

$$\begin{cases} \frac{dy_1}{dt} = y_2; \\ \frac{dy_2}{dt} = \beta_1 + \beta_2 y_2 + y_1^2 + y_1 y_2, \end{cases} \quad (20)$$

where $\beta_1 = -\frac{\mu_1^2}{4\xi^4}$; $\beta_2 = \frac{\mu_1}{2\xi^2} - \frac{\mu_2}{\xi}$.

So, we obtained a system of differential equations in the standard form (1). Hence, it is not difficult to find bifurcation curves on which system (20) has a "saddle-node" bifurcation and a Hopf bifurcation. The "saddle-node" bifurcation is characterized by the fact that only one bifurcation curve from singular points passes through the bifurcation point. A Hopf bifurcation is a local bifurcation when a stationary point of a dynamical system loses stability, and this loss of stability leads to the appearance of periodic solutions.

First, we note that stationary points (equilibrium states) are given by the relation:

$$(y_1^*;\ y_2^*) = \left(\pm\sqrt{-\beta_1};\ 0\right). \quad (21)$$

They have always existed since $\beta_1 < 0$. Linearization around these points leads to the expression:

$$\mathbf{F} = \begin{pmatrix} 0 & 1 \\ \pm\sqrt{-\beta_1} & \beta_2 \pm \sqrt{-\beta_1} \end{pmatrix}.$$

It follows that the point $\left(+\sqrt{-\beta_1};\ 0\right)$ is stable, and the point $\left(-\sqrt{-\beta_1};\ 0\right)$ is a source when $\beta_2 > \sqrt{-\beta_1}$ or a drain when $\beta_2 < \sqrt{-\beta_1}$. Thus, the Hopf bifurcation takes place on the curve $\beta_2 = \sqrt{-\beta_1}$, and the bifurcation "saddle-node" is realized on the plane $\beta_1 = 0$ if $\beta_2 \neq 0$.

To study the stability of the Hopf bifurcation, we will make two substitutions of variables, the first of which allows us to reduce the vector field to a standard form. We will assume that $\bar{y}_1 = y_1 + \sqrt{-\beta_1}$ and $\bar{y}_2 = y_2$. In this case, we get:

$$\begin{cases} \frac{d\bar{y}_1}{dt} = \bar{y}_2; \\ \frac{d\bar{y}_2}{dt} = -2\sqrt{-\beta_1}\cdot\bar{y}_1 + \bar{y}_1\cdot\bar{y}_2 + \bar{y}_1^2. \end{cases} \quad (22)$$

Now let's use the linear transformation $\bar{y}_1 = u_2$ and $\bar{y}_2 = \sqrt{2\sqrt{-\beta_1}}\cdot u_1$, the matrix of which consists of the real and imaginary parts of the eigenvectors corresponding to the eigenvalues of this matrix: $\lambda_{1,2} = \pm i\sqrt{2\sqrt{-\beta_1}}$. Thanks to this, we get a system of differential equations, the linear part of which is written in the standard form:

$$\begin{cases} \frac{du_1}{dt} = -\sqrt{2\sqrt{-\beta_1}}\cdot u_2 + u_1\cdot u_2 + \frac{1}{\sqrt{2\sqrt{-\beta_1}}}u_2^2; \\ \frac{du_2}{dt} = \sqrt{2\sqrt{-\beta_1}} + u_1. \end{cases} \quad (23)$$

For system (23), the first Lyapunov quantity [22], which characterizes the stability of the limit cycle, has the following form:

$$l_1 = \frac{1}{16\sqrt{-\beta_1}} > 0. \quad (24)$$

Note that the Lyapunov quantities characterize how well the system "remembers" the initial state, that is, they determine the local stability and instability of a weak focus. A positive Lyapunov indicator shows how quickly points located next to each other diverge. The negative Lyapunov indicator shows how quickly the system recovers after an external impact, that is, it determines the time required for the system to recover the limit cycle. Accordingly, the Hopf bifurcation is subcritical, and we have a family of unstable periodic orbits surrounding the flow (stable focus) when the value of the parameter β_2, is less than $\sqrt{-\beta_1}$, but close to this value.

Next, we determine whether a global bifurcation occurs. Perhaps this is a loop of a saddle-focus separatrix in which the limit cycle disappears and the stable and unstable manifolds of the saddle point "cross". To study such a bifurcation, we apply the scale transformation:

$$y_1 = \varepsilon^2 v_1; \quad y_2 = \varepsilon^2 v_2; \; \beta_1 = \varepsilon^4\alpha_1; \quad \beta_2 = \varepsilon^2\alpha_2; \quad \varepsilon \geq 0\,. \quad (25)$$

We will also introduce a new variable that characterizes the time $\tau \to \varepsilon\cdot\tau_0$. And system (19) takes the form:

$$\begin{cases} \frac{dv_1}{dt} = v_2; \\ \frac{dv_2}{dt} = \alpha_1 + \varepsilon\alpha_2 v_2 + \varepsilon v_1 v_2 + v_1^2. \end{cases} \quad (26)$$

Assume $\varepsilon = 0$. Then, with a fixed value of the parameter $\alpha_1 \neq 0$, system (26) can easily be transformed into a Hamiltonian system, which is a particular case of a dynamic system and is characterized by the fact that it does not have dissipation:

$$\begin{cases} \frac{dv_1}{dt} = v_2; \\ \frac{dv_2}{dt} = \alpha_1 + v_1^2. \end{cases} \quad (27)$$

And this system has a Hamiltonian, i.e. fixed income:

$$H(v_1,\ v_2) = \frac{v_2^2}{2} - \alpha_1 v_1 - \frac{v_1^3}{3}.$$

This transformation makes it possible to perform integration. Now it becomes clear the motivation for the scale changes, which were made according to relations (25). We can perform a perturbation of the global phase curves of the system of differential equations (27), and this will allow us to determine the behavior of the system (20) for the case when β_1 and β_2 are close to zero. The search for saddle loops is reduced to the search for values of α_2 and $\varepsilon \approx 0$, for which a saddle connection is realized. Such a problem can be solved using Melnikov's method [20]. The solution is given by the formulas:

$$\begin{aligned} v_1^0(\tau_0) &= 1 - 3\,sech^2\left(\frac{\tau_0}{\sqrt{2}}\right), \\ v_2^0(\tau_0) &= 3\sqrt{2}\,sech^2\left(\frac{\tau_0}{\sqrt{2}}\right) th\left(\frac{\tau_0}{\sqrt{2}}\right). \end{aligned} \quad (28)$$

In this case, the Melnikov's function $M(\tau_0)$ is stationary, and it can be specified as follows:

$$M(\alpha_2) = \int_{-\infty}^{\infty} v_2^0(t)(\alpha_2 v_2^0(t) + v_1^0(t))\,dt.$$

After integration, we equate the Melnikov function to zero and obtain the corresponding value $\alpha_2 = \frac{5}{7}$. This gives an approximate formula for the bifurcation curve in terms of parameters β_1 and β_2:

$$\beta_1 = -\frac{49}{25}\beta_2^2; \quad \beta_2 \geq 0.$$

The real bifurcation line is tangent to the given semiparabola at the point $\beta_1 = \beta_2 = 0$. In addition, it is essential that the trace of the linearization matrix is positive:

$$\mathrm{tr}\mathbf{F} = \beta_2 + \sqrt{-\beta_1} = \frac{12}{5}\beta_2 > 0\cdot$$

So, it was founded out that the production and economic system (9) has two equilibrium positions. There are a compound focus and saddle. The above qualitative analysis (by trajectories) of the structural stability of this system describes to a situation where both equilibrium positions are very close to each other. If the parameter that characterizes the level of conditionally constant costs increases to its critical value $c_0^* = \frac{a(b-c)^2}{4}$, both equilibrium positions merge with each other and then disappear. Therefore, the system loses its stability, which is called a "fold" in the phase space. In the case when the dynamic parameter ξ is close to $\xi^* = \frac{b-c}{2}$, in system (9) a complex focus gives birth to an unstable limit cycle, which is characterized by a rigid regime of self-oscillations.

DISCUSSION

The mathematical model of production and economic object proposed in this paper makes it possible to analyze the qualitative behavior of such nonlinear dynamic systems when changing the parameters which characterize these systems, allows describing states that are far from equilibrium, and also makes it possible to predict a sharp change in the state of the system when a slight change in its parameters. It is appropriate to compare the obtained results with the data published in the paper of K. Sasakura [23], as well as in the paper of G. Feichtinger [24], which were performed within the framework of the theoretical results of T. Kiselova and F. Wagener [25]. Although these researches are devoted to the study of the behavior of nonlinear dynamic systems in the economy, the systems considered in them are significantly different from the production and

economic system that is the object of our research by the nature of their functioning. It should also be noted that in these papers one-parameter bifurcations of the limit cycle type were analyzed without taking into account the global rearrangement of phase trajectories on the two-parameter plane. Results similar to ours were obtained in the research of L. Cheng and L. Zhang [26], where when determining changes in population size in the "predator-prey" model, the possibility of the existence of a different bifurcation structure in the plane of parameters depending on the value of the Lyapunov quantity was revealed. Similarly, as it was done in the mentioned research on the example of the "predator-prey" system, we considered the possibility of existence of Bogdanov-Takens bifurcation for the economic system of nonlinear dynamics, when both coefficients of the characteristic equation can change signs. Just this possibility is a prerequisite for the appearance of the "double zero" bifurcation, that is, the Bogdanov-Takens bifurcation.

It should be noted that knowing the location of bifurcation points and the type of bifurcation that is realized at this point is of great importance, as it marks the transition from one mode of dynamics to another. The very fact of the presence of two positions of equilibrium, which we discovered in the process of qualitative analysis of the production and economic system, leads to a radical restructuring of the understanding of the dynamic behavior of the economic system. However, if the level of conditionally constant costs reaches a critical value, then a catastrophic loss of stability occurs in the system, and such a loss for this cycle is irreversible. Such phenomena should be considered dangerous modes of functioning of the production and economic system, and they are obviously associated with sharp jump-like imbalances, with exterminatory market failures and, apparently, they can be explained only within the framework of the analysis of nonequilibrium systems. The most significant in this sense is the existence of a periodic regime at extremely low frequencies and, accordingly, very long periods of oscillations. This testifies to the theoretical possibility of the appearance of ultra-long waves in the evolution of the economic object under study. In other words, it can be argued that there are so-called "turning points" that change the direction of economic development. Similar to the long waves of the economic conjuncture proposed by Kondratiev, such points are distant from each other by large time intervals. But they have an even more greater distance, that is, such waves can be considered as super long.

Although the model of the production and economic system proposed by us can be considered as a sufficiently simplified formalization of only some qualitative and quantitative characteristics of the functioning of an economic and economic object, but such a formalization made it possible to obtain general information about the development trajectories of this system and its stationary states with the identification of the most significant critical modes functioning. The application of the proposed model for forecasting the evolution of the production and economic system gives the best results in the short- and medium-term time intervals, but in the long-term the model additionally needs to determine the limits of the quantitative forecast, if the required horizon of the quantitative forecast (numerical data) much exceeds the duration of the industrial cycle.

CONCLUSIONS

The resulting mathematical model allows describing the behavior of the production and economic system at a sufficiently high level of generalization, i.e. it gives an idea of the existence of certain phase trajectories of development. This model can be used for any integral economic unit for which an independent closed cycle of reproduction is implemented. Due to this formalization, general information was obtained regarding the trajectories of the system's development and its stationary states, with the identification of the most significant critical modes of functioning, such as the breakdown of the steady state. The study of bifurcations that can arise in the system showed that it is a bifurcation of the local "saddle-node" type, the appearance of which leads to the birth of a cycle, and also a global bifurcation with the presence of a separatrix cycle, which distinguishes periodic and aperiodic types of system development. Using this model, a decision-maker can maintain the stability of a complex system in which feedback takes place. A further step can be simulation modeling using this model to obtain quantitative characteristics of the stability of the system states by assigning specific values to the system parameters.

A feature of the mathematical model of economic dynamics presented by the authors in this paper is the assumption that the evolution of the production and economic system is continuous over time. Since the characteristics of the system are measured at fixed points in time, the subject of further research may be the construction of a similar model for determining processes described in discrete time. The construction of such models requires the use of another mathematical apparatus, namely, equations in finite differences.

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Нелінійна математична модель динаміки виробничо-господарських об'єктів

Анатолій Віталійович Воронін, Ірина Леонідівна Лебедєва, Степан Сергович Лебедєв

Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна

Анотація. Особа, що приймає рішення щодо керування виробничо-господарським об'єктом, відчуває потребу в інструментах для вирішення численних проблем, що виникають у процесі функціонування цього об'єкта як економічної системи в умовах взаємодії з навколишнім середовищем. Метою даної роботи є побудова аналітичної моделі виробничо-економічної системи, яка б дозволяла досліджувати структурні зміни, що можуть відбуватися в процесі функціонування господарських об'єктів із замкнутим циклом виробничої діяльності і які визначають можливі шляхи еволюції відкритої економічної системи у часі (траєкторій розвитку). Для побудови моделі було застосовано методологію нелінійної динаміки й економічної синергетики. У роботі запропоновано математичну модель виробничо-економічної системи з невеликою кількістю фазових змінних, що мають ринкову інтерпретацію, та визначені ендогенні та екзогенні параметри, які характеризують стан системи і напрям її розвитку. Модель містить систему двох звичайних диференціальних рівнянь з квадратичною нелінійністю. Така формалізація дозволила отримати загальну інформацію щодо траєкторій розвитку цієї системи і її стаціонарних станів з виявленням найбільш значущих критичних режимів функціонування. Якісний аналіз на основі цієї моделі показав, що нелінійність призводить до неєдиності станів рівноваги та до існування як стійких, так і нестійких траєкторій еволюції досліджуваної економічної системи. Ця модель може бути використана для керування будь-якою цілісною господарською одиницею, в якій забезпечується самостійний замкнутий цикл відтворення

Ключові слова: економічна динаміка, математична модель у неперервному часу, нелінійна динаміка, синергізм, фазові траєкторії еволюції, стійкість точок рівноваги, біфуркація

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Analysis of Organizational and National Culture Values of the Personnel in a Multinational Organization: A Case of China

Tetyana Lepeyko*, Miao Jianping

Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine

Abstract. The problem of personnel management of a multinational company, where the personnel represents a specific national culture, but for the efficient performance of the organization, must fully accept its organizational culture, is relevant for business now. This is what provokes a conflict between the values of the personnel's national culture, which are always shared by the carriers of this culture and the expected personnel's behavior, which is a manifestation of the organizational culture. The purpose of the study is to conduct an analysis of the values of the personnel's organizational and national culture in a Chinese multinational organization (School of Economics and Management of Neijiang Pedagogical University) based on a value approach to determine a possible conflict between the national and organizational culture of the personnel in this organization and to develop practical recommendations for eliminating this conflict to increase the personnel effectiveness in a multinational organization in the context of Chinese culture. The scientific methods that were used are methodological approaches developed by M. Rokeach, S. Schwartz and G. Hofstede for the study of personnel's organizational and national culture in an organization based on the value approach. The main results of the analysis of the personnel's organizational and national culture in this Chinese multinational organization indicate a significant influence of the personnel's Chinese national culture (for the personnel being the carrier of this culture) on the personnel's organizational culture in this organization and the presence of a conflict between the personnel's organizational and national culture. The practical significance of the obtained results is that the proposed recommendations for adjusting the structure of personnel's values will allow the management of the company to eliminate the conflict between the personnel's national and organizational culture and increase the efficiency of this personnel

Keywords: cultural level, value approach, value orientation, multinational team, value profile, levels of culture, cross-cultural management

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INTRODUCTION

In the context of the increasing impact of globalization on business development in all countries of the world, research and analysis of culture at the national and organizational level in multinational organizations is a pressing problem, which is addressed by both scientists and researchers in the field of cross-cultural management. Thus, according to the approach of G. Hofstede [1] to defining levels of culture, the basis of the dominance of national culture are the values shared by the carriers of this national culture, and the organizational culture of the organization, which is fixed in the behavior of the personnel and is manifested through rituals, heroes and symbols inherent in this organization. In this respect, an important aspect of obtaining a competitive advantage in a multinational organization is the condition that the national culture of the personnel in the organization does not conflict with the organizational culture of the organization, but is accepted by its personnel [2]. Since national culture is a stable set of values, beliefs, norms, traditions, stereotypes, behaviors, customs and attitudes, which is characteristic only of the carriers of this national culture and is the basis of their national identity [2]. That is why national cultures are compared at the level of values, and organizational cultures can be explored by comparing patterns of behavior of staff and analyzing the level of symbols, heroes and rituals. The organizational culture is a management tool and can be accepted by the carriers of

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*Corresponding author

different national cultures (being common to them), and the national culture should be accepted as a fact for each organizational culture [1].

Organizational culture is a tool for managing personnel by maximizing the alignment of the values inherent in the organizational culture with the values of the multinational team (their national culture), which is the basis and carrier of this organizational culture. E. Schein [3] notes that the technology of effective management of the organizational culture is based on defining the sets of optimal combinations of elements of the organizational culture in the organization, and the main task of personnel management is to adapt the organizational culture to the personnel of a particular multinational organization [2]. Thus, the national culture of the personnel in an organization operating in this country is influenced by a significant number of factors (religious, economic, political, historical, social, climatic etc.) and establishes requirements for the activities of this organization, determines the style and model of personnel management [1].

Thus, since it is the values, attitudes and behaviors that form value schemes [4] of an individual or a particular culture [5] in order to "perceive, think, reason, act, react and interact" [6], it is therefore proposed to use a value-based approach to study and analyze the culture (national and organizational culture) of the personnel in a multinational organization. Thus, in order to study culture on the basis of a value approach, it is necessary to determine the structure of the system of values that are the core of each culture [7]. The purpose of this study is to analyze the values of the organizational and national culture of the personnel in a Chinese multinational organization, namely School of Economics and Management of Neijiang Pedagogical University, based on the methodological approaches of M. Rokeach, S. Schwartz and G. Hofstede.

In his work, M. Rokeach [4] identified two key definitions: values and value orientations. Values as a type of belief determine the basic principles of an individual's life. Since values play a key role in the system of individual beliefs, because they determine the behavior, lifestyle, aspirations and desires of the carrier of these values. And value orientations are "abstract (positive or negative) ideas not related to a particular object or situation, which express human beliefs about the type of behavior and the dominant goal" [4]. S. Schwartz, by the term "values" means "goals that are desirable and go beyond specific situations, and differ from each other in importance and are also guiding principles in human lives" [8]. Scholars [9-11] highlight the following main characteristics of values within the framework of the modern concept of values:

1. Values are beliefs (thoughts) inextricably linked to affects. When values are activated, they are filled with feelings.

2. Values are personally desirable goals and behaviors (motivation to act) that contribute to the achievement of these goals.

3. Values are not limited to certain actions and situations, they are beyond their scope, that is, they are transcendent. This feature distinguishes values from norms and attitudes that usually belong to specific actions, objects or situations.

4. Values act as models or criteria that determine the choice or assessment of actions, deeds, people and circumstances. A person decides what is good or bad, justified or illegal, what should be done and what should be avoided, on the basis of possible consequences for their dominant values. But the impact of values on everyday decisions is rarely conscious. Values become conscious when the actions or judgments that an individual considers have contradictory consequences for the different values he or she cherishes.

5. Values are sorted successively by significance. An ordered set of values forms the structure of values that characterize each person as an individual. Different cultures are also characterized by different value structures. The existence of such hierarchy among values also distinguishes them from norms and attitudes.

6. The relative importance of a multitude of values determines actions. Any attitude or behavior usually has consequences for more than one value. The trade-off between relevant competing values determines relationships and behaviors [12]. Values influence actions when they are appropriate in the context (hence can be activated) and important to the actor. Value orientations, as a form of manifestation of the values of an individual, are elements of the internal (dispositional) structure, formed and recorded in the process of socialization and social adaptation of the individual by adopting (or not adopting) specific values in line with the main life goals and specific ways of their implementation [13]. Scholars [10; 14; 15] note that value priorities are influenced by the position of the individual in the social structure and the experience thus obtained (education, age, gender, occupation, etc.). Furthermore, each person has a unique experience (traumas, relationship with parents, immigration, etc.) that also influences value priorities [11].

Consequently, a comparison of the value priorities of groups and individuals can reveal the impact of the main social changes (changes in economic and political conditions) and a particular experience (emigration, disease) to which social subgroups are exposed. The peculiarity of this study is the identification of a possible conflict between the national and organizational culture of the personnel of a multinational organization and the development of practical recommendations for eliminating this conflict to increase the effectiveness of the personnel of a multinational organization in this country (national culture).

MATERIALS AND METHODS

The main directions of research of values in cross-cultural management are carried out at two levels (Fig. 1): 1) only at the level of the individual (individual differences). In this case, the unit of analysis is the individual. For each individual, values are the guiding principles of life and the main motivational goals [4; 9]; 2) only at the level of culture (differences in social culture). When analyzing values only at the level of social culture (differences in social norms, customs and traditions of social groups), social groups become units of analysis [7].

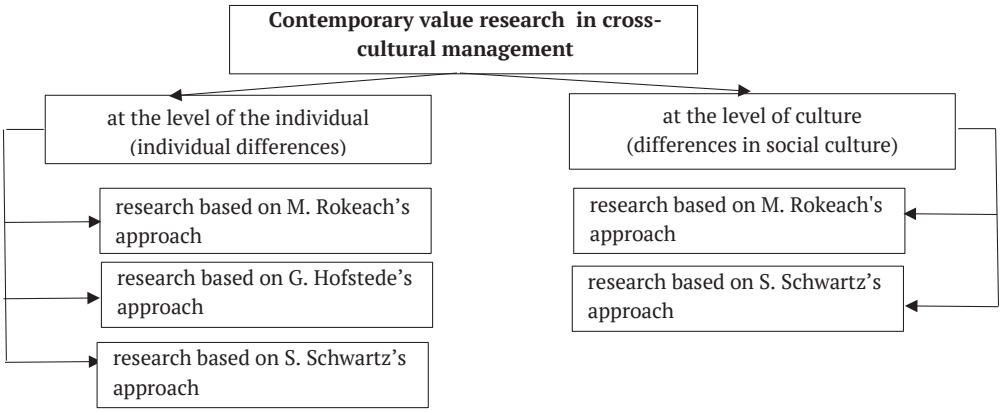

Figure 1. Directions of research of values in cross-cultural management

Source: systematized on the basis of [1; 7; 16]

M. Rokeach's approach allows to explore values both at the level of an individual and at the level of social culture. In his approach, M. Rokeach identifies two types of values [4]:

1) terminal values are "the belief that certain ultimate goals of individual existence deserve to be pursued from a personal and societal point of view". It is this type of values that determines the main goals of an individual's life, has a long-term perspective and is achieved through instrumental values. Terminal values are the result of socialization (formation up to the age of 14-16 years), so they hardly change in adulthood.

2) instrumental values are "the belief that a certain way of acting is better in any situations from a personal and social point of view". As they are determined at each specific stage of the individual's understanding of a life situation, their change occurs every time when the individual feels the inconsistency of these values.

It is the belonging to culture (national, organizational) that determines, according to M. Rokeach [4], the hierarchical structure of values both terminal (manifestation of national culture) and instrumental (manifestation of organizational culture). Based on the results of the ranking of values (terminal and instrumental), hierarchical structures of these values are obtained for a specific social group (or individual). An in-depth analysis of the structure of each group of values is carried out on the basis of the following classification presented in Figure 2.

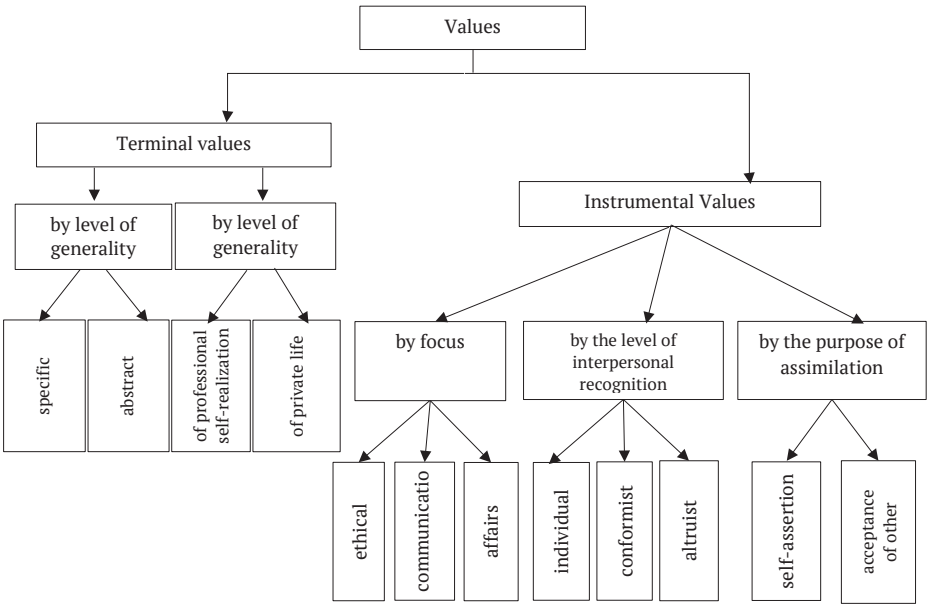

Figure 2. Classification of values

Source: formed on the basis of [1; 17]

In modern cross-cultural research such as the World Values Survey (WVS) [18], the European Social Survey (ESS) [19] and the European Value Survey (EVS) [20], the study of the value structure was carried out using the methodological approach of S. Schwartz. This approach to the study of individual values is based on M. Rokeach's theory [4] and S. Schwartz's theory on the motivational goals of value orientations and the universality of basic human values [8].

According to S. Schwartz [8], the nature of values and their structure is universal, but different social groups

have a different value hierarchy (priority). And the study of values can be carried out only at the level of the individual, and only at the level of culture. S. Schwartz developed two tools designed to measure values based on S. Schwartz's theory [8]:

1) Schwartz Value Survey (SVS) [10];

2) Portrait Values Questionnaire (PVQ) [10] – as an alternative to SVS.

The Schwartz value theory defines ten common values according to the motivation that underlies each of them [8]. Comparative characteristics of motivational types of values according to their central purpose are presented in Table 1. In different national and social groups, the importance of the ten values identified by S. Schwartz varies, but the coherence of the hierarchical order of values is always emphasized, since in representative samples the ranks of ten values are quite close [10].

Table 1. Comparative characteristics of motivational types of values

Motivational type of value	Definitive Objective	Elements
Self-direction	Autonomy in thinking, independence in action, freedom in creativity and research activities	Creativity, freedom, independence, curiosity, definition of life goals, self-respect, intelligence, confidentiality
Stimulation	Desire for experiences, novelty, challenge to life	Courage that captivates life, varied life
Hedonism	Enjoyment or sensual pleasure (pleasure, enjoyment of life)	Pleasure, enjoying life, indulging personal desires*
Achievement	Achieving personal success through competence and in line with social standards	Ambition, influence, success, ability, self-respect, public recognition**
Power	Presence of a certain social status, control of people and resources	Authority, social power, wealth, preservation of personal public image and public recognition
Security	Personal safety and safety of others, own harmony and stability of relationships, harmony in society	Social order, family security, national security, neatness, mutual service, health, moderation, sense of belonging
Conformity	Self-restraint of actions and inclinations that will harm or upset others or violate social norms (expectations)	Obedience, courtesy, self-discipline, reverence for parents and elders, loyalty, responsibility
Tradition	Acceptance, respect and commitment to the ideas and customs of culture (religion)	Respect for traditions, modesty, piety, acceptance of personal share in life, moderation, spiritual life
Benevolence	Preservation and strengthening the well-being of the immediate circle	Helpfulness, responsibility, honesty, fidelity, forgiveness, true friendship, mature love, loyalty, indulgence, helping others
Universalism	Well-being, comprehension, gratitude, tolerance, protection of nature and people, understanding	Broad outlook, social justice, quality, worldwide peace, world of beauty, unity with nature, wisdom, environment protection

Notes: * happiness is an important value, it is not included in hedonism, as people feel it when achieving any results that they value [21];

** the values of achievement are different from the motivation for achievement [22]. The motivation for achievement is related to compliance with internal quality standards and is expressed in the values of self-direction

Source: formed on the basis of S. Schwartz's theory [8; 10]

G. Hofstede [1] notes that his approach (6-D model) is merely a conception and framework for further development, and the indices underlying this approach are an analytical tool for understanding intercultural differences. In his approach, G. Hofstede identifies the following indices, based on which it is possible to assess the values of an individual as a representative of a particular national culture: "power distance"; "individualism versus collectivism"; "masculinity versus femininity"; "uncertainty avoidance"; "long-term orientation versus short-term orientation"; "pleasure versus restraint orientation".

According to the approach of G. Hofstede [1], the value of each index is measured quantitatively in points (from 0 to 100), where 0 is the lowest value and 100 is the highest (although the values may exceed this limit). These indices are absolute, i.e. in any culture there is a manifestation of both opposite values of the dimension, but their ratio will be different. It is possible to evaluate individual values based on the quantification of indices, comparing representatives of different national cultures. Figure 3 systematizes the values that are characteristic of each of the extreme values of these indices. Comparative characteristics of the main approaches to the study of values both at the level of the individual and at the level of social culture are presented in Table 2.

VALUES	Index	
	Power Distance	
	High (51-100)	Low (0-50)
	tolerance of power, obedience, comfort	equality, justice, freedom, independence
	Individualism versus collectivism	
	Individualism (51-100)	Collectivism (0-50)
	self-reliance, initiative, responsibility, self-esteem, independence, self-realization, competition, rationality	subordination, care, mutual assistance, harmony, absence of conflict, balance, respect, compromise, morality, confidence, stability
	Masculinity versus femininity	
	Masculinity (51-100)	Femininity (0-50)
	perseverance, self-confidence, heroism, success, ambition, career, competition, materialism, independence, determination	compromise, modesty, concern for others, harmony, absence of conflicts, compassion, equality, solidarity, prudence, discretion
	Uncertainty avoidance	
	High (51-100)	Low (0-50)
	accuracy, deliberateness, security, tradition, suspicion, control	riskiness, autonomy, self-reliance, innovation, confidentiality, delegation
	Long-term orientation versus short-term orientation	
	Long-term orientation (51-100)	Short-term orientation (0-50)
	loyalty, diligence, perseverance, frugality	consumption, reliability, stability, traditions, "preservation of individuality"
	Indulgence versus restraint	
	Indulgence (51-100)	Restraint (0-50)
	enjoyment of life, pleasure	restraint, austerity

Figure 3. Values specific to each index

Source: formed on the basis of [1; 2; 23]

Table 2. Comparative properties of the approaches to the study of values

Advantages	Disadvantages
M. Rokeach's approach	
1. Universality, the method can be applied in various value-related studies. 2. Convenience, this is a fully ready-to-use method. 3. Economy in the process of conducting, processing and analyzing the results obtained. 4. Flexibility, the presentation form of lists of values provided may vary depending on the conditions of the study	1. The list of the values provided is not complete, only 36 values are highlighted. 2. Openness, when conducting the study, many respondents can respond in the way that "society assumes", as it will be right from their point of view, which makes it difficult to obtain reliable results for a particular respondent
S. Schwartz's approach	
1. Universality, the possibility of obtaining a circular structure of values in all cultures allows for the use this method in different countries. 2. Veiled values, values are presented in the form of questions that characterize them, which contributes to obtaining more sincere answers	1. Orientation to the measurement of only those attitudes that are significant for the respondents in the process of interpersonal relationships, affecting the norms of the environment, which are automatically considered to follow on from the values of the respondent.
G. Hofstede's approach	
1. Universality of the use of the method in different cultures	1. The limited list of the values provided does not cover all aspects of life values

Source: the result of the authors' own research

Thus, it is determined that each of these methodological approaches to assessing values has both advantages and disadvantages, and, importantly, all these approaches are characterized by universalism – they can therefore be used in this study comprehensively since they assess values at different levels of culture (organizational and national).

Within the framework of this study, an online survey [24] of employees of a multinational organization, namely School of Economics and Management of Neijiang Pedagogical University, located in China, was conducted in the period July-October 2021. The respondents were lecturers from the School of Economics and Management of

Neijiang Pedagogical University. Based on the approach to defining the essence of a multinational organization given in [2], this organization is a multinational one since multinational relations of the personnel of this organization are established with both other foreign universities (representatives of other national cultures) and with students, among which there are also representatives of other national cultures. A total of 100 employees of this Chinese multinational organization were interviewed, including 32% men and 68% women. Moreover, according to the survey results, all respondents interviewed were identified as representatives of Chinese national culture. Based on the survey results, the values of these respondents were analyzed using the three discussed approaches (RVs, PVQ and 6-D model).

RESULTS AND DISCUSSION

Upon analyzing the results of the survey of the personnel in the Chinese multinational organization, the following hierarchy of values was obtained (Table 3) taking into account M. Rokeach's approach. In the structure of terminal values characterizing the national culture of respondents, the following features are noted:

1) in terms of generalization – high significance among terminal values of specific terminal values (54%) compared to abstract values (46%), rejecting only abstract values;

2) the dominant importance of the values of professional self-realization (54%) over the values of private life (46%).

In the structure of instrumental values that characterize the organizational structure of this multinational organization, the following features are noted:

1) by directionality – ethical values (49%) dominate values of affair (28%) and values of communication (23%);

2) by the level of interpersonal recognition – conformist values dominate individual and altruistic ones;

3) by the purpose of assimilation – values of acceptance of others dominate values of self-assertion.

Table 3. Hierarchy of values of the personnel of the Chinese multinational company (M. Rokeach's approach)

Group of values by importance [2]	Terminal values (national culture)			Instrumental Values (organizational culture)			
	Value	by level of generality	by role in life	Value	by directionality	by the level of interpersonal recognition	by the purpose of assimilation
the most important (ranks 1-6)	1. Health	s	–	1. Responsibility	e	cm	–
	2. Active Life	s	–	2. Intelligence and education	a	i	sa
	3. Inner harmony	a	ps	3. Independence	e	i	sa
	4. Financially secure life	s	–	4. Diligence	a	–	sa
	5. Love	a	–	5. Good breeding and courtesy	c	–	–
	6. Life Wisdom	a	pl	6. Self-control	e	cm	ao
important but not mandatory (ranks 7-12)	7. Cognition	a	–	7. Neatness	a	–	–
	8. Happy family life	s	pl	8. Tolerance	c	a	ao
	9. Interesting work	s	ps	9. Honesty	c	–	ao
	10. Development	a	ps	10. Rationalism	a	i	–
	11. Freedom	a	pl	11. Courage in defending personal opinions, views	a	i	sa
	12. Social recognition	s	ps	12. Joyfulness	c	–	–
not important (ranks 13-15)	13. Productive Life	s	ps	13. Intransigence to personal shortcomings and shortcomings of others	c	I	sa
	14. True friendship	s	pl	14. High requests	e	–	sa
	15. Satisfaction	s	pl	15.Breadth of outlook	e	Cm	ao
rejected (ranks 16-18)	16. Pursuit of beauty	a	–	16. Sensibility	c	A	ao
	17. Happiness of Others	a	–	17. Efficiency in affairs	a	–	sa
	18. Creativity	a	–	18. Strong will	a	I	sa

Notes: distribution of terminal values: 1) by the level of generalization: c – specific terminal value; a – abstract terminal value; 2) by the role in life: ps – terminal value of professional self-realization; pl – terminal value of private life. Distribution of instrumental values: 1) by directionality: e – instrumental ethical value; c – instrumental value of communication; a – instrumental value of affair; 2) by the level of interpersonal recognition: i – individual instrumental value; cm – conformist instrumental value: a – altruistic instrumental value; 3) by the purpose of assimilation: cm – individual value of self-assertion; pi – individual value of acceptance of others

Source: the result of the authors' own research

On the basis of the results of the PVQ-based analysis (S. Schwartz's approach), a value profile wis developed for the personnel of the Chinese multinational organization under study (Fig. 4) and a hierarchy of values of this personnel was obtained (Table 4). The value profile of male and female respondents notes differences in values such as power, tradition, benevolence, stimulation, and achievement.

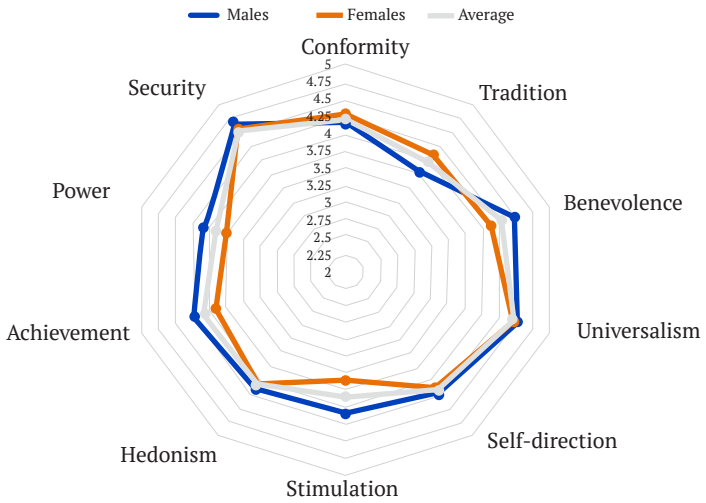

Figure 4. Value profile of the personnel of the Chinese multinational organization (Schwartz's approach)
Source: the result of the authors' own research

Table 4. Value hierarchy of the personnel of the Chinese multinational organization

Value	Place in the lives of Chinese respondents			Universal hierarchy [8]
	Males	Females	Total	
Benevolence	3	4	3	1
Universalism	2	2	2	2
Self-direction	5	5	5	3
Security	1	1	1	4
Conformity	6	3	4	5
Hedonism	7	7	6	6
Achievement	4	8	7	7
Tradition	10	6	8	8
Stimulation	9	10	10	9
Power	8	9	9	10

Source: the result of the authors' own research

However, an analysis of the hierarchy of these values in these groups of respondents shows that the difference in the value hierarchy of male and female respondents is noted only for such values as conformity, achievement and tradition. It is in this way that the influence of China's national culture is manifested:

1. The higher position of the value of conformity in Chinese female respondents (3 in women, 6 in men) indicates the influence of national culture (masculinity and restraint of Chinese culture), since the values of conformity are associated with the containment of actions, inclinations and impulses that can upset or harm others or violate social expectations or norms (restraint of Chinese national culture), and this is found in women (masculinity of Chinese culture).

2. The higher position of the value of achievement in Chinese male respondents (4 in men, 8 in women) indicates a significant influence of national culture (masculinity of Chinese culture), since the values of achievement are associated with the desire for personal success, and this is more important for the male part of the respondents.

3. The higher position of the value of tradition in Chinese women respondents (6 in women, 10 in men) indicates the influence of the pragmatism of Chinese national culture (long-term orientation).

The hierarchy of values of the personnel of the Chinese multinational organization under study looks the following way (Table 5). The results of the values analysis taking into account G. Hofstede's approach are presented in Table 6.

Table 5. Value hierarchy of the personnel of the Chinese multinational organization

Motivational type of value	Elements of value [8]
1 Security	social order, family security, national security, neatness, mutual service, health, moderation, sense of belonging
2. Universalism	broad outlook, social justice, quality, worldwide peace, world of beauty, unity with nature, wisdom, environment protection
3. Benevolence	helpfulness, responsibility, honesty, fidelity, forgiveness, true friendship, mature love, loyalty, indulgence, helping others
4. Conformity	obedience, courtesy, self-discipline, reverence for parents and elders, loyalty, responsibility
5. Self-direction	creativity, freedom, independence, curiosity, definition of life goals, self-respect, intelligence, confidentiality
6. Hedonism	pleasure, enjoying life, indulging personal desires
7. Achievement	ambition, influence, success, ability, self-respect, social recognition
8. Tradition	respect for traditions, modesty, piety, acceptance of personal share in life, moderation, spiritual life
9. Power	authority, social power, wealth, preservation of personal public image and public recognition
10. Stimulation	courage that captivates life, varied life

Source: the result of the authors' own research

Table 6. Values of national and organizational culture

Index value according to [25]	National culture	Organizational culture [1]: family
High power distance (80)	inequality	tolerance of power, obedience, comfort
Collectivism (20)	subordination, care, mutual assistance, harmony, absence of conflict, balance, respect, compromise, morality, confidence, stability	–
Masculinity (66)	perseverance, self-confidence, heroism, success, ambition, career, competition, materialism, independence, determination	–
Low level of uncertainty avoidance (30)	flexibility, pragmatism	riskiness, autonomy, self-reliance, innovation, confidentiality, delegation
Long-term temporary orientation (87)	loyalty, diligence, perseverance, frugality	–
Restraint (24)	restraint, austerity	–

Source: systematized and based on G. Hofstede's approach [1; 25]

Thus, the most important values that were identified as a result of the analysis of the personnel values in the Chinese multinational company based on the approaches of M. Rokeach, S. Schwartz and G. Hofstede are presented in Table 7.

Table 7. The most important values of the personnel of the Chinese multinational company

Levels of culture	M. Rokeach's approach	S. Schwartz's approach	G. Hofstede's approach
National culture	health, active, industrious and interesting life, inner harmony, materially comfortable life, love, life wisdom	social order, family safety, national security, tidiness, mutual service, health, moderation, sense of belonging, broad outlook, social justice, quality, worldwide peace, world of beauty, unity with nature, wisdom, environment protection, usefulness, responsibility, honesty, fidelity, forgiveness, true friendship, mature love, loyalty, indulgence, helping others, obedience, courtesy, self-discipline, reverence for parents and elders, loyalty, responsibility, creativity, freedom, independence, curiosity, defining life goals, confidentiality	inequality, subordination, care, mutual assistance, harmony, absence of conflict, balance, respect, compromise, morality, confidence, stability, perseverance, self-confidence, heroism, success, ambition, career, competition, materialism, independence, determination, diligence, perseverance, frugality, restraint, austerity
Organizational culture	responsibility, intelligence and education, independence, diligence, good breeding and courtesy, self-control		tolerance for power, obedience, comfort, riskiness, autonomy, self-reliance, innovation, confidentiality, delegation

Source: the result of the authors' own research

As a result of this study of the personnel values in the School of Economics and Management of Neijiang Pedagogical University located in China, it has been found that there is a conflict between the national and organizational culture of the personnel of this multinational organization. Since the hierarchy of the personnel values in the Chinese multinational organization, which was obtained on the basis of S. Schwartz's approach, differs from the universal hierarchy defined by S. Schwartz in his study [8], which indicates a significant level of personnel control in this organization and significantly increases the importance of security values for the personnel of this organization,

thus reducing the employees' desire for creativity. Additionally, this study is complex, since the national and organizational levels of the personnel culture in this multinational company are analyzed simultaneously using three methodological approaches (RVs, PVQ and 6-D model), which distinguishes this study from the study presented in [2], where the national culture is analyzed on the basis of G. Hofstede's approach (6-D model), and the analysis of the organizational culture is based on the modified methodological approach of M. Rokeach (RVs). Moreover, as a result of this study, a list of the most important values as components of the national and organizational culture of the personnel in this company has been obtained, allowing to formulate specific proposals for the development of organizational culture in the multinational culture under study; this being different from the results of the study cited in [1] that are more theoretical, general in nature and not brought to the level of practical recommendations.

CONCLUSIONS

Upon analyzing the values of the personnel organizational and national culture of the Chinese multinational organization on the basis of the approaches by M. Rokeach, S. Schwartz and G. Hofstede, the following conclusions were made.

1. The organizational culture of the personnel of this organization is significantly influenced by the personnel national culture (Chinese culture). This is primarily the masculinity and restraint of Chinese culture (the higher position of the value of conformity in Chinese female respondents and the higher position of the value of achievement in Chinese male respondents). Moreover, the pragmatism (long-term orientation) of Chinese national culture has a significant impact (the higher position of the value of tradition in Chinese women respondents).

2. The hierarchy of the personnel values of the Chinese multinational organization differs from the universal hierarchy highlighted by S. Schwartz, and these differences are explained by the influence of national culture. Thus, the values of security, which take the 4th position in the universal hierarchy, are ranked 1st by the personnel of the Chinese multinational organization – this is a characteristic of Chinese national culture and a manifestation of its collectivism. The values of self-direction, which take the 3rd position in the universal hierarchy, are ranked 5th by the personnel of the Chinese multinational organization. This confirms the results obtained during the values analysis taking into account M. Rokeach's approach, since it has been found that such terminal value as freedom is important, but not mandatory, terminal value in creativity is rejected at all, but it is also a manifestation of the influence of national culture. The values of benevolence, which take the 1st position in the universal hierarchy, are ranked 3rd by the personnel of the Chinese multinational organization. This confirms the results obtained in the values analysis based on M. Rokeach's approach, since it has been found that the instrumental values of communication and instrumental altruistic values are less important for respondents; happy family life is also an optional terminal value, and true friendship is an unimportant terminal value. These are the basic elements of the value of benevolence.

3. Since the organizational culture of this organization is a tool for personnel management, it is proposed to pay attention to the value of benevolence, self-direction and security. The importance of the values of benevolence of the organization's personnel must be raised since it is these values that provide an internal motivational basis for positive, joint social relations and are the main guideline for the constant acquisition of values. Thus, the significance of the values of security that have been acquired in this organization in response to requirements and sanctions will decrease in order to avoid risks, control prohibited impulses and limit oneself. And this reduces the effectiveness of innovations in quest for group management solutions. It is also important to stimulate the increase of the importance of the values of self-direction in the personnel, as they promote creativity, motivate innovation and help to cope with difficulties. Behavior based on these values is intrinsically motivated because it meets individual needs without harming others and rarely threatens positive social relations.

The area of further research is the formulation of practical recommendations for the development of the organizational culture in the analyzed multinational culture on the basis of the peculiarities of the national culture of its personnel, taking into account the system of the personnel values.

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Аналіз цінностей організаційної та національної культури персоналу мультинаціональної організації: приклад Китаю

Тетяна Іванівна Лепейко, Мяо Цзяньпін

Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна

Анотація. Актуальною для бізнесу зараз є проблема управління персоналом мультинаціональної компанії, який є представником конкретної національної культури, але для ефективної діяльності організації має повністю приймати її організаційну культуру. Саме так виникає конфлікт між цінностями національної культури персоналу, які завжди поділяються носіями цієї культури та поведінкою, яку очікують від персоналу та яка є проявом організаційної культури. Мета дослідження – це проведення аналізу цінностей організаційної та національної культури персоналу китайської мультинаціональної організації (Школи економіки та менеджменту Педагогічного університету Нейцзян) на основі ціннісного підходу для визначення можливого конфлікту між національною та організаційною культурою персоналу цієї організації та розробка практичних рекомендацій щодо усунення цього конфлікту для підвищення ефективності діяльності персоналу мультинаціональної організації в умовах китайської культури. Наукові методи, які були використані – це методичні підходи, розроблені М. Рокічем, С. Шварцом та Г. Хофстеде щодо дослідження організаційної та національної культури персоналу організації на основі ціннісного підходу. Основні результати аналізу цінностей організаційної та національної культури персоналу цієї китайської мультинаціональної організації свідчать про суттєвий вплив китайської національної культури персоналу (як носіїв цієї культури) на організаційну культуру персоналу в цій організації та наявність конфлікту між організаційною та національною культурою персоналу. Практичне значення отриманих результатів полягає в тому, що запропоновані рекомендації щодо корегування структури цінностей персоналу дозволять керівництву компанії усунити конфлікт між національною та організаційною культурою персоналу та підвищити ефективність праці персоналу

Ключові слова: культурний рівень, ціннісний підхід, ціннісна орієнтація, мультинаціональний колектив, ціннісний профіль, рівні культури, крос-культурний менеджмент

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Trends in the Development of Accounting in the Context of Ukraine's European Integration Aspirations

Natalia Ryzhikova[1*], Iryna Serova[2], Iryna Shevchenko[2]

[1]State Biotechnological University
61002, 44 Alchevskykh Str., Kharkiv, Ukraine

[2]Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine

Abstract. The relevance of the research topic lies in revealing of the trend of accounting in the context of Ukraine's European integration aspirations through the study of theoretical issues and experience of Ukraine. The reforming of accounting has already been launched in Ukraine, but this path is quite difficult and slow; however, it is of great importance in the formation of the economic significance of Ukraine and its adaptation to international requirements. In recent years, reform has become even more important, as the country's European integration aspirations determine the rapid development of all economic sectors. Today's challenges, such as the aftermath of the COVID-19 pandemic and military action in Ukraine, are modifying business conditions and making it urgent to propose ways to reform and address trends in accounting in Ukraine. The purpose of the study is to reveal the trend of accounting in the context of Ukraine's European integration aspirations through the disclosure of theoretical issues and experience. The analysis of the problem proved that a large number of problems associated with the development of accounting existed, and there was an urgent need for its detailed study and solution. The results of the study highlighted the features of accounting in the European integration environment and the characteristics of the stages of development of accounting. The practical significance of the research results is the possibility to apply them on the Ukrainian enterprises in order to improve the skills of accountants in theoretical knowledge and possible application in the discipline of "Accounting" in universities

Keywords: globalization, development trends of accounting, harmonization, standardization, reforming

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INTRODUCTION

Maintaining proper financial assets, financial stability and rational use of resources of any enterprise are not only the key objectives of its activities, but also an important aspect of the functioning of the economy as a whole. Providing up-to-date information to business management to make timely decisions allows them adapting to changes in the internal and external environment and maintain financial discipline at an effective level. This task is largely entrusted to the accounting service. Currently, the Ukrainian system of financial reporting and recording of transactions on enterprises is designed in such a way that can meet the information needs of the company only in retrospect, and is mainly aimed at external users, which are usually tax officials and government or private auditors. The formalism of accounting, limiting the methodology to national standards leads to the lag of the Ukrainian accounting system from modern challenges of the business environment. As of today, difficult conditions for modifying economic reality (globalization, European integration, growing competition, the phenomenon of information relations, the speed of technological innovation, the spread of scientific and technical developments, knowledge, increasing the role of intelligence) and the difficulties Ukraine has encountered in recent years such as COVID-19 pandemics of 2020, the full-scale military invasion of the Russian Federation on Ukrainian territory in February 2022 showed that the existing accounting system was unable to respond effectively to any changes. The main manifestation of this problem was the complex implementation of the developed legislative norms that came into force during this period.

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*Corresponding author

Improving and reforming the accounting system will significantly improve its current state and allow for further growth, creating competitive conditions for businesses. The reform process has been going on for decades and aims at the gradual adoption of legal documentation that brings Ukrainian accounting closer to international and to ensure the implementation of digital technologies in the process of compiling and reporting. However, the changes that take place are usually superficial and do not act as a factor in qualitative changes. A distinguishing feature of the national accounting regulation is the desire to unify it not at the level of general methodology, but at the level of details. Implementation of minor changes is a prerequisite for reforms. This is a typical connection between change and reform, elements of the system that cannot function alongside existing ones. A more visible problem that arises on this basis and which is usually addressed in the circles of scholars and practicing accountants is the lack of elaboration and making the necessary adjustments to all regulations relating to a particular object of accounting, so each innovation produces additional contradictions in the legal framework. Their total number tends to increase every year and is a mean of manipulation by regulatory authorities. Restrictions on the choice of accounting tools are also often accompanied by a lack of clear instructions for their implementation, which encourages practicing accountants to avoid working with this object of accounting and distort information about its availability to avoid penalties, which also emphasizes the system targeting external users. Taking into account the listed facts, the question of identifying the ways of development of accounting, which are characterized by effectiveness and aimed at improving the economic situation in the country, considering international experience, is gaining relevance. Although the priority for Ukraine today is to maintain the level of production at enterprises on a reproductive scale at all stages of the process, the choice of the trajectory of further changes in accounting is necessary, because economic transformation is inevitable for the state. The research method serves as the disclosure of accounting development trends in the conditions of Ukraine's European integration aspirations.

LITERATURE REVIEW

Since the beginning of 2014, many works have been written to investigate the issues of accounting development trends in the context of Ukraine`s European integration aspirations, which is primarily related to the beginning of the path towards European integration. Such foreign scientists and specialists as I. Steccolini, I. Saliterer, J. Guthrie [1], and Ukrainian scientists and specialists as H. Isanshyna [2], L. Kononenko [3], I. Spilnyk, M. Paliukh [4], studied the development of this process and the development of accounting in Ukraine and in general. Over the last three years, there has been even more work on this issue, because the faster the development of European integration, the more important it is to study its trends. The latest fundamental research on this issue was carried out by such foreign scientists as I. Chen, H. Chen [5] and Ukrainian scientists L. Tovkun [6], V. Shpak [7], H. Kolisnyk, [8], who concluded that there was a need to reform the entire institutional environment, including an interconnected set of systems of accounting, analysis, audit and taxation through current trends and paradigm shift in management, the main feature of which was a shift towards a process-oriented approach to management. At the level of accounting practice, there should be improved interaction with information users, building closer and coordinated interaction between accounting and auditing and internal control, implementation of international standards, consolidation of regulatory framework, implementation of modern software products in business practice. The results obtained remain relevant, but need to be supplemented, given that society is currently facing a number of unforeseen circumstances, primarily the consequences of the COVID-19 pandemic that caused a lot of shifts in the international economy, which in turn affects the organization of accounting. An important work in this regard was made by R. Aissaoui, and F. Fabian [9], which made it possible to identify the types of globalization that have emerged as a result of the pandemic, and to examine their impact on the general state of economies, depending on their income and corruption. In the work of K. Zirnhold and L. Jung-Ivannikova [10], the issue of corruption and economic development in the Ukrainian context is revealed. This emphasizes the need to consider the international experience of accounting. Along with the ongoing European integration processes, the current state of hostilities in Ukraine needs special consideration, which makes it necessary to think ahead and study the peculiarities of the functioning of countries in the postwar period in terms of enterprises and challenges of the information system of each entity. The work of R. Moore [11] is dedicated to this topic. After analyzing a sample of post-war periods during 1970-2008, he concluded that accelerating the process of resuming foreign direct investment in the war-torn economy and clarifying key uncertainties was achieved by strengthening policies, areas of information transparency and reporting management. An important area of research to reform the accounting system in the context of European integration is to gain an understanding of the characteristics of economic entities in the European Economic Area, which was shown the work of B. Mercedes [12]. This work is focused on identifying features that should be introduced into the national economy, taking into account regional features. These studies serve as a basis for the development of the peculiarities of the development of accounting and the characteristics of trends in its development in the context of European integration. The scientific novelty of the study lies in shaping proposals of the stages of development of accounting by systematizing the events associated with it, and proposing trends in the development of accounting in the context of Ukraine's European integration aspirations.

MATERIALS AND METHODS

A distinguishing feature of this study is the examination and consideration of socio-economic processes that were carried out through the analysis of scientific activities and its results, as well as by identifying relevant interests and current problems and needs of society. The epistemological structure of this study is a type of subjective-objective relationship. The study presents the results of the work of economy scientists. The methodological basis of the study are general philosophical and general scientific methods. The authors developed a program that contains theoretical

and methodological validity, interrelated elements and their logical sequence and relationship. The program of scientific and economic research allowed the reveal of the understanding of the research topic, identify problems and propose its scientific solution based on scientific methods. During the study, special scientific methods and special scientific technologies were applied. Using the methods of scientific knowledge – induction, grouping and comparison, it was proposed to improve the methodical and methodological aspects of accounting only on the basis of research theory and experience of other countries. The first step in the process of rational reform should be to gain an understanding of the current state of the system, so to fully disclose the research topic, it was considered appropriate to highlight the features of accounting in Ukraine's European aspirations through research on the knowledge of modern economists. The study is based on a systematic approach, which became the basis for the development of accounting in the context of Ukraine's European integration aspirations. Historical, civilizational and institutional approaches were used in the study of accounting development, which allowed characterizing the events related to the development of accounting. The presentation of scientific facts in the study was carried out in the context of the general historical process of accounting in Ukraine, the history of the accounting industry in terms of European integration aspirations, taking into account general and specific features.

According to the authors, consideration and study of historical experience, namely the disclosure of stages of formation, development of accounting in the context of Ukraine's European integration aspirations and proposing its trends has greatly enriched scientific research and testifies to the reliability of its results and conclusions.

The use of methods of grouping, comparison and concretization allowed the establishing of convergences and divergences between historical phenomena and the opportunity to generalize them.

The use of methods of causation of accounting allowed establishing the characteristics of its development in the context of Ukraine's European integration aspirations and identify trends. Identifying the problems associated with the peculiarities of the accounting system functioning (COVID-19 and martial law), studying the regulatory and legislative framework and understanding the risks – all this allowed explicitly examining the adaptation of the accounting system in today`s conditions as one from the trend of its development in the present study. The comparative legal method is used to determine the consequences of the proposed trends in the European integration of Ukraine by studying the features of the accounting system of different countries and comparing legal norms, institutions, principles and practices of its application. The European integration aspiration in the field of national economy puts forward many demands, and economists are currently concerned about the unification of accounting and statistics. The main approach is harmonization and standardization.

The analysis of trends in accounting in the context of Ukraine's European integration aspirations allowed ensuring that adaptation to European practice would be an important element in the optimizing the mechanism of the Ukrainian accounting model.

The information base of the study is the work of the leading contemporary foreign scholars on accounting issues, legislative documents on the organization and maintenance of accounting.

RESULTS AND DISCUSSION

Trends and patterns of accounting development in the context of promoting sustainable socio-economic growth of the state with the help of European experience have been subject to attention for many years, because the conditions and requirements for accounting and financial reporting of enterprises in this case will undergo significant changes. The process of reforming and improving the accounting aspect of the information system of Ukrainian enterprises was characterized by point changes that did not take into account the general state of the system and its readiness to implement certain types of changes [7].

Improving specific methodical and methodological aspects of accounting only on the basis of research theory and experience of other countries, whose accounting systems are not comparable with the Ukrainian, led to confusion in the theoretical basis and difficulties in the practical application of certain rules. Thus, the first step in the process of rational reform should be to gain an understanding of the current state of the system, so to fully disclose the research topic, it is important to consider the features of accounting in Ukraine's European integration aspirations (Fig. 1).

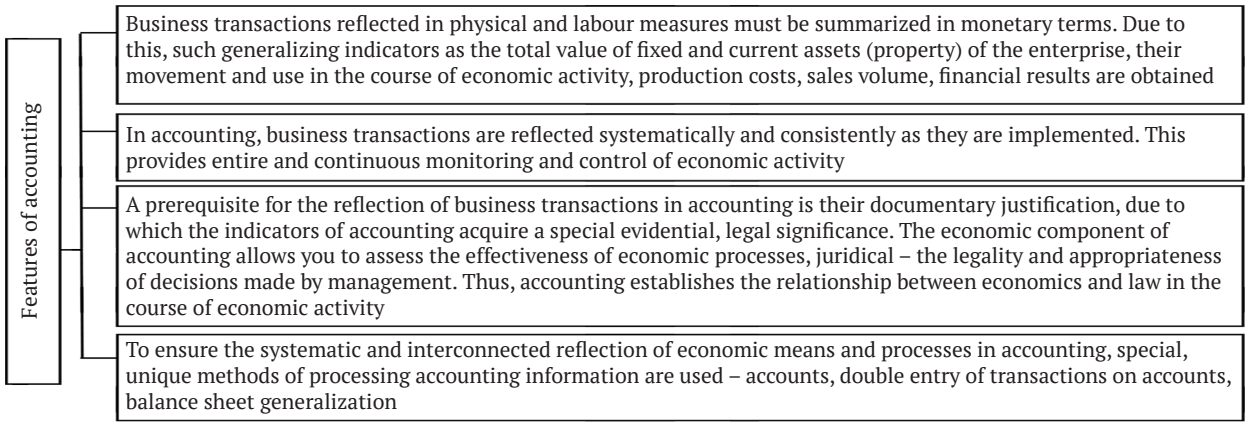

Figure 1. Features of accounting in the context of Ukraine's European integration aspirations
Source: generalized by authors based [3; 4]

As can be seen from Figure 1, the features have a certain nature of implementation, are subject to strengthening and do not contradict international practice, so there is a need for a retrospective review of the accounting system in Ukraine to identify clear areas for further influence. By analyzing the existing trends in the development of Ukrainian accounting, it was concluded that the modern accounting model was close to the continental one. This is due to Ukraine's choice of the European integration vector of development (Table 1).

Table 1. Characteristics of events related to the development of accounting

Period	Characteristics of the stage
1991	Economic reforms aimed at expanding the powers of economic entities, changing the methods of planning and costing, improving the chart of accounts, mechanization of accounting, the creation of specialized software for accounting automation
1999	Adoption of the Law of Ukraine "On Accounting and Financial Reporting in Ukraine" and national accounting standards (P (S) BO) (Accounting regulations (standards)), developed on the international basis [13]
2000	The process of creating a domestic accounting system.
2000	Providing opportunities for small businesses to transition to a simplified system of taxation, accounting and reporting, if its criteria meet the provisions of the Law of Ukraine "On State Support of Small Business" of 19.10.2000 № 2063-W [14]
During 2001	Gradual introduction of new (P (S) BO) (Accounting regulations (standards)) [15]
2001	Approval of the chart of accounts for accounting of assets, capital, liabilities and business operations of small businesses
2003	Approval of "Recommendations for the use of accounting registers in small enterprises" (1 book or 5 statements and balance sheet) [16]
2007	The development of the accounting system in the public and private sector was provided by the "Strategy for the modernization of the accounting system in the public sector for 2007-2015" [17]
2011	Federation of Professional Accountants and Auditors of Ukraine. The Federation has translated and published accounting manuals according to international standards in Ukrainian International Accounting Standards [18]
2011	Adoption of the Tax Code of Ukraine dated 12/02/2010 No. 2755 – VI as amended by the Law of Ukraine dated 07/07/2011 No. 3609 – VI The tax system in Ukraine is changing dramatically. The number of taxes is significantly reduced [19]
2013	In Ukraine, from 01/01/2013, national regulations (standards) of accounting in the public sector come into force. The standards currently adopted govern the recognition of assets and liabilities, the presentation of financial statements, the formation of consolidated financial statements, segment financial statements, and the determination of revenue. New forms of financial reporting have been introduced and the methodology for compiling the balance sheet has been improved [20]
2014	According to the Strategy of Development of Ukraine "Ukraine-2020: Strategy of National Modernization", developed by the Ministry of Economy of Ukraine in 2014, provides for: reforms in the economy, based on an innovative model of development of all spheres of public life, creating an innovative product optimality of directions of innovative activity of enterprises [21]
2014 – present time	Significant changes in the Law of Ukraine "On Accounting and Financial Reporting in Ukraine" [22]
2018	Strategy for modernization of the accounting and financial reporting system in the public sector until 2025 [23]
2020	Changes in accounting are related to Covid-2019 [24]
2021	Significant changes in regulations: updating accounting standards, changing the rules for calculating the average for vacation and payment of days of earnings, updating the accounting of state employees [25]
2022	Changes are being made to the accounting system in connection with the imposition of martial law [26]

Source: Report on recipients of state support in the agricultural sector [31]

As can be seen from Table 1, accounting in Ukraine has come a long way in its becoming, improving and reforming. According to the authors, 2011 and 2014 can be considered significant turning points; these are the years of highlights for the development of accounting in Ukraine. The analysis of events allowed formulating the stages of development of accounting in Ukraine, which are shown in Figure 2.

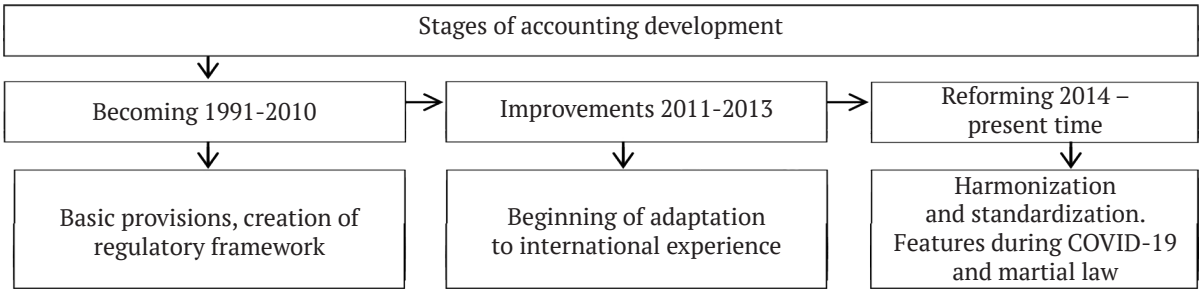

Figure 2. Stages of accounting development

Source: completed by the authors

As can be seen from Figure 2, the stages are conditionally divided into three groups, at the stage of formation of accounting in Ukraine began building its system since independence. There was a need to create a new system, new laws, bylaws, regulations and resolutions. A lot of work has been done in this direction. 2011 is characterized by the adoption of the Tax Code of Ukraine [19] and changes required by new laws. As a result, the tax system in Ukraine is changing dramatically. The number of taxes is significantly reduced. This immediately caused a great impetus in the development of accounting.

In 2014, the Federation of Professional Accountants and Auditors of Ukraine translated and published in Ukrainian International Accounting Standards [18], accounting manuals according to international standards. Accounting in Ukraine has become a symbiosis of administrative and market concepts, national and international standards. During this period, there were many comparisons of the existing system with the international one. An attempt was made to harmonize Ukrainian and international accounting. However, as with any improvement, there were negative consequences associated with the lack of necessary changes in current accounting legislation. The problem of limited accounting has become acute, which is manifested in the use of double entry or monetary measurement, passive application of certain principles, the priority of tax rules, the inefficiency of scientific research. 2019 was a difficult year for businesses and the accounting system, a year of pandemics, when there was a need to immediately adapt to a new life. Uncertainty among entrepreneurs due to COVID-19, forced the immediate development of special tools to ensure the integrity, reliability and consistency of their activities. There is a need to study the peculiarities of accounting and the risks that arise in the face of new challenges and uncertainties.

In today's world of martial law, the legal restriction and closure of many businesses will lead to increased work to reflect liquidation procedures, and liquidity risks will increase rapidly; there will be a need to reallocate loans and other liabilities; the tax consequences are unpredictable; transfer of funds to military funds, reflection in the accounting and taxation of aid received, etc. However, the adaptation of the accounting system as one of the trends in its development exists and continues. Therefore, it is proposed to consider the main trends in accounting.

As can be seen from Figure 3, an approximation of the terminological and conceptual apparatus by identifying the main differences between the standards is proposed. Thus, it is necessary to compare the general requirements for the preparation of financial statements. Many issues are disclosed in the (P (S) BO) (Accounting regulations (standards)) [15], but unfortunately do not find practical application, which causes some confusion, which is why the interpretation of fair presentation of financial statements in the context of the (P (S) BO) (Accounting regulations (standards)) [15] and International Financial Reporting Standards may differ. The next step is to consider the limitations of accounting approaches. Unfortunately, the (P (S) BO) (Accounting regulations (standards)) [15] does not contain all the detailed information on international standards. Limitation of requirements for disclosure of information that deprives users of financial statements is necessary for making management decisions. Contradictions between the standards cause major problems for the proper functioning of the accounting system. The trend of accounting development implies the maximum approximation of the economic essence and content of the Ukrainian categorical-conceptual apparatus to international practice. The confusion also concerns the Tax Code of Ukraine [19], so the solution of these problems that have arisen in accounting should be based on the following: systematization and streamlining of theoretical categories that are already formulated and used effectively, revision of terms provided by bringing accounting terms to unambiguous, adequate perception their users and on the formation of new classifications of concepts and the choice of features taking into account European integration (Fig. 3).

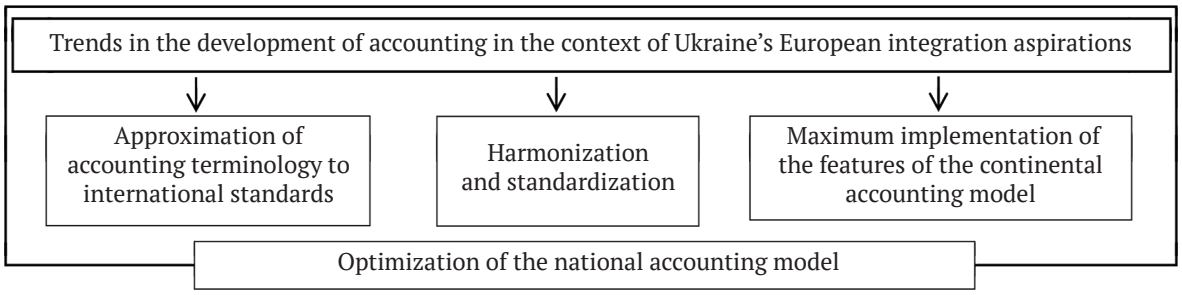

Figure 2. Stages of accounting development

Source: completed by the authors

European integration into the economy addresses the problem of unification of accounting and statistics. The main approaches to solving this problem are harmonization and standardization. The analysis of trends in accounting in the context of Ukraine's European integration aspirations shows that adaptation to European practice can be a major element of the optimization mechanism of the Ukrainian accounting model. An analysis of existing trends in the development of Ukrainian accounting shows (Fig. 3), however, that the modern accounting model is close to the continental one. This is due to Ukraine's choice of the European integration vector of development. Therefore, it is proposed to support and implement it in the national environment.

CONCLUSIONS

Thus, the study of the development of the accounting system in Ukraine is an important problem, the solution of which should be done systematically, considering the historical development of national accounting and changes in the external business environment that are happening

now. Due to the need for active, effective and vigorous development of international economic ties, which were weakened during the COVID-19 pandemic, as well as investment in activities that will take place after the end of hostilities in Ukraine and its gradual recovery, rethinking approaches need to be rethought, focusing on maximum transparency and meeting the needs of management in the first place, existing economic categories and their interpretations need to be reconsidered, terms emerging in the digital age and new to accountants need to be clarified. The development of accounting is strongly connected with the processes of globalization, which contribute to the interpenetration and mutual enrichment of the best achievements of international professional organizations worldwide. That is why the successful implementation of financial reporting standards in accounting practice is the key to the successful accession of professional accountants of Ukraine the international scientific community. The proposed development patterns are based on three important aspects of an effective accounting system. The development of accounting according to these patterns will accelerate the optimization of the Ukrainian accounting model. Further research should focus on developing mechanisms to minimize the negative impact of the imperfection of the legislative aspect, as well as its inconsistency with the provisions of the international legal framework, programs to adapt Ukrainian innovative methods of accounting and reporting to international experience. The direction of further research can also highlight the updating of tools and methods of influencing the accounting system.

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Тенденції розвитку бухгалтерського обліку в умовах євроінтеграційного прагнення України

Наталія Іванівна Рижикова[1], Ірина Анатоліївна Сєрова[2], Ірина Олександрівна Шевченко[2]

[1]Державний біотехнологічний університет
61002, вул. Алчевських, 44, м. Харків, Україна

[2]Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна

Анотація. Актуальність теми дослідження полягає у розкритті тенденції розвитку бухгалтерського обліку в умовах євроінтеграційного прагнення України за допомогою вивчення теоретичних питань та набутого досвіду. За останні роки реформування набуло ще важливішого значення, тому що євроінтеграційне прагнення країни зумовлює стрімкий розвиток всіх економічних ланок. Виклики сьогодення, такі як наслідки пандемії COVID-19 та воєнні дії на території України, модифікують умови функціонування підприємств та зумовлюють нагальну необхідність у пропонуванні шляхів реформування та розгляді тенденцій розвитку бухгалтерського обліку в Україні. Мета дослідження полягає у розкритті тенденції розвитку бухгалтерського обліку в умовах євроінтеграційного прагнення України за допомогою розкриття теоретичних питань та набутого досвіду. Методологічною основою дослідження є загально філософські та загальнонаукові методи. Для виконання поставленої мети у дослідженні авторами було складено програму, яка містить теоретико-методологічну обґрунтованість, взаємопов'язані елементи та їх логічна послідовність та зв'язок. В основу дослідження покладено системний підхід, який став основою для розвитку бухгалтерського обліку в умовах євроінтеграційного прагнення України. При дослідженні розвитку бухгалтерського обліку використовувався історичний, цивілізаційний та інституційний підходи, що дозволило охарактеризувати події пов'язані із розвитком бухгалтерського обліку. Результати дослідження полягають у виокремленні особливостей обліку в євроінтеграційних умовах та характеристиці етапів розвитку бухгалтерського обліку. Практична значущість результатів дослідження полягає у використанні їх підприємствами України з метою підвищення кваліфікації бухгалтерів з теоретичної обізнаності та можливе застосування у дисципліні «Бухгалтерський облік» в університетах

Ключові слова: глобалізація, тенденції розвитку бухгалтерського обліку, гармонізація, стандартизація, реформування

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Reinsurance Management in the Global Financial Market Cyclicity Conditions

Viktor Smoliak[1*], Zhanna Andriichenko[2]

[1]Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine

[2]Baden-Wuerttemberg Cooperative State University
76133, 121 Erzbergerstr, Karlsruhe, Germany

Abstract. The globalization of economic relations and the integration of Ukraine into the world financial market have significant impact on decision-making in an insurance company in Ukraine. These aspects actualize the study of the insurance companies' activities in the conditions of world financial market cyclical development, and it determines the purpose of the article. The purpose of the study is to develop theoretical and methodological provisions and practical recommendations for managing reinsurance in conditions of cyclical development of the global financial market. Solving the tasks set in the research was carried out using scientific methods of analysis, synthesis, induction, deduction, and analogy – to study trends in the development of the Ukrainian insurance market; logical generalization – to determine the peculiarities of reinsurance management in conditions of cyclicity of global financial markets; comparative and statistical analysis – for analyzing the share of premiums belonging to non-resident reinsurers; Fourier analysis – for analyzing the cyclicity of the development of the global financial market and the reinsurance market in Ukraine. Global business activity develops cyclically. The first cycle is long-term and consists of 14 quarters. Within the long-term cycle, harmonics of a shorter cycle, namely 1 year, were detected. The reinsurance market in Ukraine also develops cyclically. The length of the cycle is 4 quarters. It was established that the peaks of the harmonic oscillations of the development cycle of domestic reinsurance and the world cycle of business activity are antiphase, that is, the phase of the oscillations differs by half a period. The length of the domestic reinsurance development cycle and the global business activity cycle are equal, and the distance between the extremes of the cycle functions is 2 quarters. The practical value of the obtained results is that the established relationships between the cycles and phases of the global business activity development and the reinsurance market of Ukraine provide a toolkit for making management decisions regarding the modeling of a reinsurance portfolio effective structure in the insurance company

Keywords: insurance, reinsurer, economic cycles, business activity

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INTRODUCTION

Insurance occupies an important place in the financial system of the state. In Ukraine, the insurance market is the second in terms of capitalization after the banking market [1]. Insurers are active investors and important participants in the capital market. The stability and active development of the insurance market is an important element of the stability of the economic relations of the state in general and the financial system in particular. The stability of the insurance market is based on many factors, one of which is reinsurance. The risk transfer mechanism ensures financial stability of the insurer regardless of the size of its capital, assets and insurance reserves. Reinsurance is a risk management tool for primary insurers to reduce the volatility of their losses and relieve them of single peak risks.

The Ukrainian insurance market is quite integrated into the world insurance market. Ukrainian insurance companies transfer risks to reinsurance not only to Ukrainian companies, but also to foreign partners. Any trends in the global financial market in general, and the insurance market in particular, significantly affect the insurance market of Ukraine. The globalization of economic relations and integration of Ukraine into the world financial market actualize

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*Corresponding author

the issue of managing reinsurance in an insurance company in the conditions of the cyclicity of the world financial market.

Reinsurance is a derivative of insurance, so trends in the development of the insurance market have a significant impact on the reinsurance market. In 2021, the transformation of the insurance market of Ukraine continued. In particular, 55 insurers were excluded from the State Register of Financial Institutions in 2021 [2]. The part of the companies on the insurance market of Ukraine did not conduct any activity for a long time. Thus, 26.5% of insurers left the market. In addition, since July 1, 2020, the National Bank of Ukraine has strengthened the requirements for insurers, namely regarding solvency, so some insurance companies leave the insurance market voluntarily and do not wait for the regulator to do so [3].

In the insurance market of Ukraine, there is a tendency to increase its concentration, strengthen government supervision and competition. During 2018-2021, the number of insurance companies in the Ukrainian market of non-bank financial services decreased by 45% [4], while the volume of assets remained almost unchanged. This indicates that insurance companies that almost did not function and did not provide insurance services are leaving the market. As a result, the stability of the insurance market is achieved, and the quality of the provided insurance services improves.

The Ukrainian insurance market has a very high concentration. In 2021, the top 10 of 142 risk insurance companies accounted for 50% of gross written premiums and 60% of gross disbursements. Ten life insurers in Ukraine accounted for 96.6% of premiums and 100% of disbursements [5].

A peculiarity of the insurance market of Ukraine is its small share in the structure of the world insurance market. Since most insurance companies of Ukraine have a small amount of assets, they must transfer their reinsurance obligations to foreign insurers. The share of premiums transferred to reinsurance was 19%. Of them, 56% belong to non-resident reinsurers [6].

In modern business conditions, the task of managing reinsurance is actualized as a result of the emergence of risks arising because of transformational trends in the Ukrainian market, as well as a result of the convergence and integration of the insurance market of Ukraine with the world financial market, which in turn is affected by cyclical development. In addition, the need to study reinsurance management issues is due to the emergence of new risk minimization tools that allow changing approaches to insurance activity, accepting more specialized and large-scale risks without the threat of losing the solvency of the insurance company.

Many Ukrainian and foreign scientists were engaged in the study of the economic essence, implementation mechanism, problems and development prospects, and the role of reinsurance in the insurance market. So, N.M. Vnukova [7] and O.V. Kneisler, N.Ya. Spasiv, S.V. Korol [8] in their works studied the current trends in the development of the Ukrainian insurance and reinsurance market, as well as the problems of its integration into the world financial market.

The issues of reinsurance management and modeling of the optimal structure of reinsurance are presented in the works of many foreign scientists. Thus, the authors of the work [9] in their study present the problems of affiliated reinsurance, protection of the insured and regulation of the insurer's capital. The scientists have developed a two-stage structure, according to which the incumbent insurer buys reinsurance from its affiliated reinsurer in the holding company in accordance with the capital regulation. According to the scientists, the survival of an affiliated reinsurer decreases in conditions of strict regulation of the insurer's activity. However, strict regulation of the insurer's capital strengthens the protection of the insured and increases the volume of optimal reinsurance. Strict regulation of the insurer's capital contributes to the stability of the insurance system.

The researchers in the scientific work [10] analyze the potential of reinsurance to avoid the reduction of capital guarantees in life insurance products. By giving the insurer the opportunity to transfer part of the financial risk to the reinsurer, the problem of optimizing the dynamic investment and reinsurance of the insurer is solved. The researchers introduce the concept of guarantee-equivalent profit to compare life insurance products with and without reinsurance. The studies show that optimally managed reinsurance allows the insurer to offer significantly higher capital guarantees to clients without any loss of the activity efficiency expected by the insurer. The longer the investment horizon and the less prone to risk the insurer, the more noticeable is the benefit from reinsurance.

The studies [11] and [12] are also devoted to the issue of optimal proportional reinsurance and investment strategies for an insurance company. The scientists offer an economic-mathematical model for insurance companies that have both normal and catastrophic risks in their portfolio and seek to maximize the expected efficiency of their capital. The optimal reinsurance strategy is proposed for insurance companies in conditions of occurrence of unpredictable environmental factors, changes in the size of aggregate claims and fluctuations in the share price, i.e. such sudden events that have an immediate impact on the financial state of the market and at the same time cause insurance cases.

The optimal structure of reinsurance coverage in the presence of counterparty risk is studied in the work [13]. From the perspective of a risk-averse primary insurer, the scientists derive a cost criterion that indicates the optimality of insufficient, excessive and full hedging of the risk of the counterparty of reinsurers. The scientists also determine optimal diversification strategies between two reinsurers that differ in counterparty risk.

Paying tribute to the developments of scientists in terms of theoretical and practical approaches to the management of optimal reinsurance in an insurance company, the problem of its further development in the conditions of globalization processes and the cyclicity of world financial markets is unresolved, which is the scientific novelty of the results of the presented study.

The purpose of the study is the development of theoretical and methodological approaches and practical tools for managing reinsurance in Ukrainian insurance companies under the influence of the cyclicity of the global financial market.

MATERIALS AND METHODS

The scientific methods of analysis, synthesis, induction, deduction and analogy are used to solve the task of the study – to study trends in the development of the Ukrainian

insurance market; logical generalization – to determine the peculiarities of reinsurance management in the conditions of cyclical world financial markets; comparative and statistical analysis – when analyzing the share of premiums belonging to non-resident reinsurers; Fourier analysis – when analyzing the cyclicity of the development of the global financial market and the reinsurance market in Ukraine.

The methods of economic-mathematical modeling are applied to the study of cyclical fluctuations as a way of simplified description of real manifestations of cyclical fluctuations. These economic models make it possible to identify causes, factors and regularities in cyclical fluctuations in the economy. In connection with the non-linear nature of the development of the market economy, the most widespread is the modeling of economic processes using dynamic systems. Harmonic analysis is used to study regular cyclical fluctuations in the economy.

The application of Fourier analysis to the research of cyclical fluctuations in the economy will be carried out with the help of an algorithm. When modeling seasonal and cyclical fluctuations, the approximation of the time series by Fourier series is used. The function specified at each point of the studied time interval can be represented by an infinite series of pairs of sines and cosines – harmonics. Finding the final sum of terms with sines and cosines is called harmonic analysis [14].

The insurance and reinsurance market of Ukraine is well integrated into the world market. This is evidenced by the fact that in the Ukrainian insurance market for 2018-2021 there is a tendency to reduce the amount of premiums transferred for reinsurance to Ukrainian reinsurers [15]. On the other hand, reinsurance among non-residents increased by 37.5% in the fourth quarter of 2021 compared to the first quarter of 2018 (Table 1) [4].

Table 1. Structure of premiums due to reinsurers

Observation date, quarter	Premiums due to resident reinsurers, billion UAH	Premiums due to non-resident reinsurers, billion UAH	The share of premiums to non-resident reinsurers in the structure of premiums due to reinsurers
Q1.18	3.5	0.8	18.60%
Q2.18	3.2	0.8	20.00%
Q3.18	2.8	0.5	15.15%
Q4.18	5.4	0.8	12.90%
Q1.19	3.7	0.8	17.78%
Q2.19	3.5	1.0	22.22%
Q3.19	3.2	0.7	17.95%
Q4.19	1.5	0.8	34.78%
Q1.20	1.9	0.9	32.14%
Q2.20	0.4	1.0	71.43%
Q3.20	1.3	0.8	38.10%
Q4.20	1.2	0.9	42.86%
Q1.21	1.1	1.2	52.17%
Q2.21	0.8	1.6	66.67%
Q3.21	0.9	1.2	57.14%
Q4.21	0.9	1.1	55.00%

According to Table 1 the specific weight of premiums to non-resident reinsurers in the structure of premiums due to reinsurers has a steady upward trend. Therefore, it is possible to assert the strengthening of the integration of the Ukrainian insurance market into the global financial market.

Since the insurance market of Ukraine is well integrated into the world market, the cyclical development of the world economy significantly affects the development of the Ukrainian financial market.

Identifying the period of fluctuations of the economic cycle and the degree of its influence on the insurance market of Ukraine will make it possible to make balanced management decisions in the management of reinsurance in an insurance company based on forecast data of the development of global business activity.

As an indicator of the development of the world economy, the work adopted the global index of business activity [16]. The observation period is 2015-2021, with quarterly frequency of observation. The sample of observation points was formed according to the data of the Federal Reserve of Economic Data [16].

Based on quarterly data on the global index of business activity for 2015-2021, using the Fourier analysis method and packages of the Statistica 10 software complex, the periods of two cycles of the development of the world economy were identified.

RESULTS AND DISCUSSION

The periodogram of the Fourier analysis results for the quarterly global index of business activity for the analyzed period is presented in Figure 1.

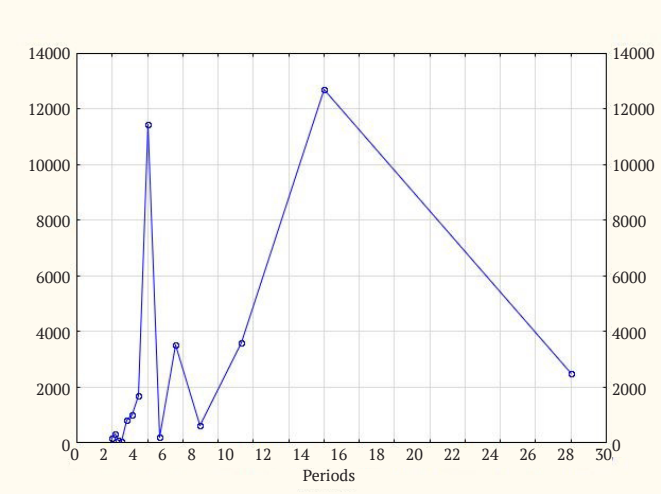

Figure 1. Periodogram of the results of Fourier analysis for the quarterly global index of business activity for 2015-2021

Figure 1 shows that global business activity develops cyclically. The first cycle is long-term and consists of 14 quarters. Within the long-term cycle, harmonics of a shorter cycle, namely 4 quarters, were identified.

As the main indicator characterizing the development of outbound reinsurance on the insurance market of Ukraine, the index of the rate of growth of premiums due to non-resident reinsurers has been adopted.

Based on the NBU data [1], the work calculates the growth rate index of premiums due to non-resident reinsurers. Based on quarterly data on the growth rate index of premiums due to non-resident reinsurers for 2015-2021, using the Fourier analysis method and the packages of Statistica 10 software complex, the period of one cycle of development of the Ukrainian reinsurance market was identified. The periodogram of the results of the Fourier analysis for the quarterly index of the growth rate of premiums due to non-resident reinsurers for the analyzed period is presented in Figure 2.

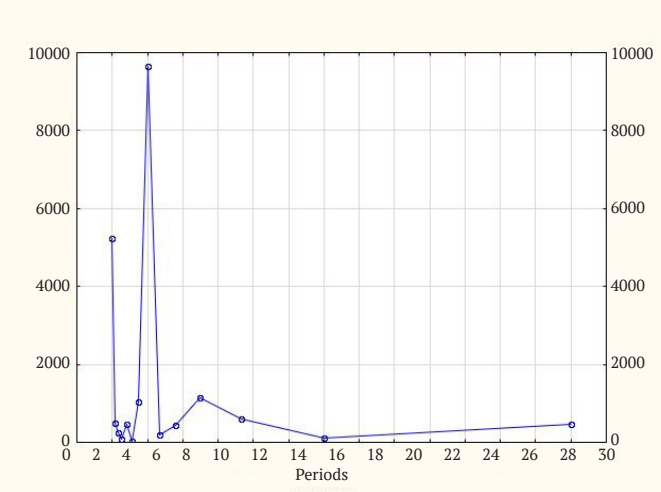

Figure 2. Periodogram of the results of the Fourier analysis for the quarterly index of the growth rate of premiums due to non-resident reinsurers for 2015-2021

It can be seen in Figure 2 that the reinsurance market in Ukraine develops cyclically. The length of the cycle is 4 quarters. Thus, it can be concluded that the length of the development cycle of Ukrainian reinsurance and the world cycle of business activity coincide.

At the next stage of the research, it was found that the peaks of the harmonics of the fluctuations of the development cycle of Ukrainian reinsurance and the world cycle of business activity have a coefficient of -1, that is, the fluctuations are antiphase, and the phase of the fluctuations differs by half a period. Since the oscillation period of the cycle is 4 quarters, half a cycle is 2 quarters. Thus, the distance between the extremes of the functions of the above cycles is 2 quarters. Therefore, it can be stated that the impact of the level of business activity on the global financial market on the Ukrainian reinsurance market is not instantaneous. Changes in trends in the Ukrainian reinsurance market occur with a delay of 2 quarters. Figure 3 presents a graph of the global index of business activity for 2015-2021. The horizontal scale shows the actual data on the dates of observation points (T). Also, Figure 3 presents a graph of the growth rate index of premiums due to non-resident reinsurers for 2015-2021. For this graph, the date values of the observation points are t=T-2, i.e., on the horizontal axis, the periods are shifted by 2 quarters for the graph of the growth rate index of premiums due to non-resident reinsurers.

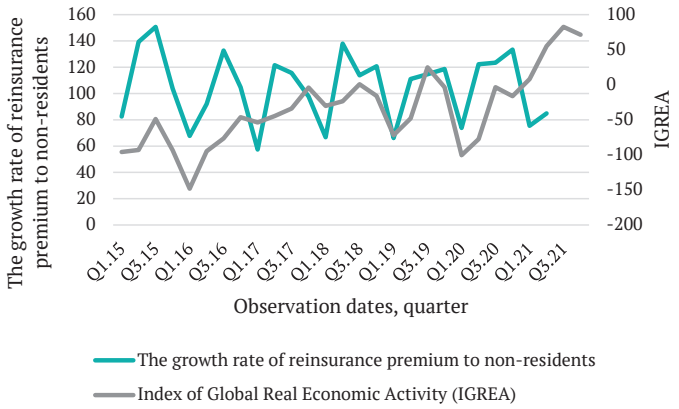

Figure 3. Comparison of the dynamics of the global index of business activity and the index of the growth rate of reinsurance among non-residents

Figure 3 shows that by shifting the graph of the growth rate index of premiums due to non-resident reinsurers by two quarters to the left, the phase of fluctuations of its harmonics coincides with the phases of fluctuations of the global index of business activity.

The obtained result has significant practical value for forecasting the development of the Ukrainian reinsurance market with a planning horizon of 2 quarters, as well as for making management decisions based on the obtained forecast indicators.

There is a tendency to increase the volume of reinsurance in the global financial market. As of the end of 2021, the total capital directed to the global reinsurance industry was US $ 728 billion, representing an increase of 8.4% compared to the previous year. In the reinsurance market, the capital for the previous year amounted to 672 billion dollars [17].

Since 2015, the total target capital in reinsurance has increased by 70%, corresponding to an average annual rate of 6%. Also, since 2015, there has been an upward trend in the volume of reinsurance premiums Figure 4.

Figure 4. Dynamics of premium growth in the global reinsurance market

Premium growth remained steady throughout 2021 at an average of 17%. This is the strongest growth rate seen since 2015. This is due to higher premium rates and growth of net new business. Return on equity also improved, increasing to 11.4% (2.7% in 2020) and 6.2% (1.3% in 2020) on a reported and underlying basis, respectively [17].

The insurance market of Ukraine was actively developing. In 2021, it increased by 8.2% from UAH 45.2 billion up to UAH 48.9 billion, including life insurance accounted for UAH 5.9 billion, and risk insurance accounted for UAH 43 billion. Insurance payments in risk types of insurance for 12 months increased to UAH 16.2 billion, in life insurance to almost UAH 800 million. The level of payments in the life sector was 13%, non-life 38%. Net life insurance premiums continued to grow rapidly, while risk insurance premiums, on the contrary, somewhat decreased [5].

Thus, it can be concluded that the current development of the insurance market of Ukraine follows the trend of growth observed by the level of global business activity in the second and third quarters of 2021. However, there is a downward trend in global business activity in the fourth quarter of 2021.

Having analyzed the above, and considering the trend presented in Figure 3, it can be concluded that the current trend towards active growth of reinsurance will be replaced by a decline in the first half of 2022. The tendency towards a break in the trend line of the growth of business activity in the world is outlined, and therefore it is possible to predict a decrease in the volume of outbound reinsurance from non-resident reinsurers on the Ukrainian insurance market in the first half of 2022.

In addition to the change in the trend of business activity in the short-term cycle, the world economy is entering a longer cycle of economic decline. According to research by the Swiss Re Institute [18], the intensity and spread of inflation leads to a rapid increase in the costs of

claims. Strong rate hikes in commercial lines and personal lines are supporting profit growth, but increasing requirements reduce profitability.

The Swiss Re Institute forecasts nominal direct premium growth of 8.0% in 2022 and 6.3% in 2023. Risks are shifted to the downside, the average projected return on capital for 2022 is 5.5% and, accordingly, 6.0% for 2023. The impact of high inflation on litigation costs is only partially offset by the investment gains from higher interest rates. Premium growth has been steady over 2015-2021 but is expected to slow in 2023 as the US economy enters a likely recession. The Swiss Re Institute predicts that the development of the insurance industry will slow down, as inflation will weaken the adequacy of the previous year's reserves [18]. In addition, the world economy is entering the recessionary phase of the economic cycle, which will also reduce global economic activity in 2022 [19].

Therefore, in view of the above, it can be concluded that the decrease in global business activity, the expected recession in the world, as well as the acceleration of inflation rates will have a negative impact on the insurance market of Ukraine as a whole, and on reinsurance in particular. In addition, inflationary pressure in Ukraine is more significant, since according to the NBU forecast, inflation will accelerate and reach 31% by the end of 2022 [20]. In 2022, the transfer of reinsurance risks to non-residents will be less profitable for Ukrainian insurers. Acceleration of inflation rates in Ukraine and the world has a double impact on reinsurance for non-residents. In the conditions of increasing rates at non-resident reinsurers due to the acceleration of inflation rates in the world, as well as the projected high level of inflation in Ukraine, the national currency depreciates in relation to settlement currencies, which has a double impact on the efficiency and rationality of reinsurance at non-resident reinsurers.

The conducted scientific research made it possible to develop practical recommendations for managing reinsurance for Ukrainian insurance companies in the conditions of the cyclicity of the global financial market:

– to monitor the level of global business activity and forecast on its basis the rate of growth of outbound reinsurance for non-residents with a planning horizon of 2 quarters. This is explained by the fact that the rate of growth of Ukrainian reinsurance volumes among non-resident insurers is cyclical in nature and the length of the cycle corresponds to the length of the short cycle of the index of global business activity, and the distance between the extremes of the cycle functions is 2 quarters;

– when developing management decisions regarding the structure of the reinsurance portfolio, be guided not only by the models of formation of the optimal reinsurance portfolio from the point of view of the balance of risks and profitability, but also take into account the cyclical nature of the development of global financial markets;

– when determining the proportion between resident and non-resident reinsurers for the formation of an effective reinsurance portfolio, long-term development cycles of the world financial markets should also be taken into account, since the expected growth of inflation and the forecasted recession significantly increase the insurer's costs for transferring risks to non-resident insurers.

CONCLUSIONS

The results of the above analysis are a convincing proof that the management of reinsurance in Ukrainian insurance companies should be carried out from a review on the integration of the Ukrainian insurance market to the world financial market, as well as on the cyclical development of the latter. The period of the short cycle of the index of global business activity is 4 quarters. The cycle period of the growth rate index of premiums transferred to non-resident reinsurers is also 4 quarters. The distance between the extremes of the functions of the above cycles is 2 quarters.

At the same time, the structure of the insurer's optimal risk diversification strategies depends not only on the objective parameters of the cost, the size of the risk, and the level of risk avoidance, but also on the trends in the development of the world financial market, expected inflation, and forecasts of the development of the world insurance market.

Despite these contributions, some questions remain open. The proportion of reinsurance among residents and non-residents in conditions of cyclical world financial markets may be of interest for further discussion in order to achieve an optimal balance between safety and costs. In this context, it should be noted that this model framework may not take into account all factors that are relevant in practice to the primary insurer's decision-making regarding its reinsurance strategy. Considering that reinsurance with non-residents can influence the solvency ratio of the Ukrainian insurer, future studies can expand this study, taking into account this relationship.

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Управління перестрахуванням в умовах циклічності світового фінансового ринку

Віктор Анатолійович Смоляк[1], Жанна Олегівна Андрійченко[2]

[1]Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна

[2]Дуальна вища школа Баден-Вюртемберга
76133, Ерцбергерштрассе, 121, м. Карлсруе, Німеччина

Анотація. Сучасні процеси глобалізації господарських відносин та інтегрованість України у світовий фінансовий ринок здійснюють суттєвий вплив на прийняття управлінських рішень в страхових компаній в Україні. Це зумовлює актуальність дослідження діяльності страхових компаній в умовах циклічності розвитку світового фінансового ринку та обумовлює його мету. Метою дослідження є розробка теоретико-методичних положень та практичних рекомендацій до управління перестрахуванням в умовах циклічності розвитку світового фінансового ринку. Вирішення завдань, поставлених в дослідженні, виконано з використанням наукових методів аналізу, синтезу, індукції, дедукції та аналогії – для аналізу тенденцій розвитку страхового ринку України; логічне узагальнення – для виявлення особливостей управління перестрахуванням в умовах циклічності світових фінансових ринків; порівняльний і статистичний аналіз – для визначення частки премій, що належать перестраховикам-нерезидентам; Фур'є аналіз – для визначення довжини циклів розвитку світового фінансового ринку та українського перестрахового ринку. Ділова активність суб'єктів економічних відносин у світі розвивається циклічно. У роботі встановлено, що довгостроковий цикл розвитку глобальної ділової активності становить 14 кварталів. В межах довгострокового циклу виявлено гармоніки річного короткого циклу. Українському ринку перестрахування теж властива циклічність розвитку. Довжина його циклу становить 4 квартали. У роботі виявлено, що піки гармонік коливань циклу світового циклу ділової активності та циклу розвитку українського перестрахування знаходяться у протифазі, тобто фаза коливань відрізняється на пів періоду. Таким чином, встановлено, що довжина світового циклу ділової активності та циклу розвитку українського перестрахування є рівними, а відстань між екстремумами функцій циклів становить 2 квартали. Практичне значення одержаних результатів полягає у тому, що встановлені взаємозв'язки між циклами та фазами розвитку світової ділової активності та перестрахового ринку України надають інструментарій для прийняття обґрунтованих управлінських рішень щодо формування ефективної структури перестрахового портфеля у страховій компанії

Ключові слова: страхування, перестраховик, економічні цикли, ділова активність

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Methods of Improving Staff Motivation System in Educational Institutions

Iryna Chmutova*, Olga Myronova, Iryna Bykhun

Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine

Abstract. Staff motivation is one of the pressing issues in management of organizations in any field of activity. This also applies to education, since the activities of employees of educational institutions have an impact on the quality of educational services and, subsequently, on the development of the state. Therefore, the administration of educational institutions should pay special attention to staff motivation. The purpose of the article is to identify methods to improve the motivation system and to achieve a balance of internal and external motivation of secondary and higher education staff. This will increase their productivity and provide education system with highly qualified specialists and will also maximize the effectiveness of their theoretical knowledge and professional skills. Using the methods of analysis, synthesis and generalization, the essence of the main concepts of the motivation system has been revealed and the classification of motivational methods has been carried out. Based on the comparative method, an analysis of the level of the average salary in Ukraine's education system and the number of its employees compared to other types of economic activity has been made. This revealed the crisis and the general financial unattractiveness of work in the education sector of the economy. A survey was conducted among teachers of higher and secondary education institutions of Kharkiv region in order to determine their motivating factors. Problems in meeting economic and socio-psychological needs of both groups of teachers have been identified. The need to feel satisfied with the process and the result of work is significantly reduced due to the low returns of pupils and students. The importance of taking into account the difference in the mentality of generations in understanding their internal motives has been substantiated. The need to optimize bureaucratic processes and technologies used in distance learning has been proven. The use of the obtained results by management of educational institutions will allow reducing the influence of demotivating factors such as unfair pay, lack of free time, stressful working conditions on the overall level of staff motivation and improving the motivation system of secondary and higher education institutionss

Keywords: staff motivation, methods of motivation, motivating and demotivating factors, higher and secondary education institutions, teachers

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INTRODUCTION

An effective staff motivation system is the key to its productive work and, as a result, the main condition for the competitiveness of any organization, in particular educational institutions. The issue of personnel management is often considered from the perspective of personnel selection, their training, adaptation and professional development not paying much attention to motivation, without which it is impossible to achieve the expected level of results. Successful management of educational institutions requires from the head not only professional knowledge, but also the ability to be such a leader for the teaching staff that understands the needs of their subordinates and the importance of certain motivating factors for them; as well as be able to motivate them to high-quality selfless work. Modern research [1] shows that the perception and behavior of students and pupils depends on the level of motivation of teachers, and this affects the final result of any educational process – the quality of education.

Researchers consider staff motivation from different sides. One of the approaches that will increase the motivation of teachers is to ensure their cooperation [2] in various aspects: during the educational process in the educational

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*Corresponding author

institution, relationships with colleagues from other institutions, participation in various state and international educational programs, etc. Another approach [3] is to ensure psychological comfort, teacher satisfaction, which affects the overall level of motivation. Researchers [4] also note that a number of factors influence the level of teachers' motivation. First, these are factors such as salary, comfortable working conditions that allow teachers to fulfill basic needs. Second, such factors as the opportunity to develop, to teach various disciplines, factors that ensure that teachers want to stay in the profession. Third, a very important factor to increase the motivation of teaches is the motivation of students and pupils, since the quality of the received education largely depends on the desire of students to learn. For the teacher, the success of students is a reflection of his/her work. Also, modern studies that research the factors affecting the motivation of teachers [5], first of all, focus attention on the internal aspects of motivation. This is due to the fact that the work of a teacher in itself is a rather altruistic job. These factors include the desire to be successful in the profession, to achieve certain recognition and set goals, even through the success of students in the future, as well as love for the profession and the desire to benefit the country and the world. However, it is necessary to remember about external aspects of motivation, since the teacher is, first of all, a person with his/her own needs that can be satisfied with the help of material resources.

Thus, in order to maximize the effectiveness of theoretical knowledge and professional skills of teachers, it is extremely important to choose such socio-economic methods of motivation that would ensure a balance of material and non-material incentives for the teaching staff. Improving the motivation system of educational institutions through an in-depth analysis of teachers' motivation mechanisms will make it possible to galvanize their work productivity and provide the industry with highly qualified specialists, increase teachers' satisfaction with their work, maintain the desire to stay in this job despite different conditions, will reduce the manifestation of the burnout syndrome inherent in many teachers.

The purpose of the article is to determine the main methods to improve the system of staff motivation of secondary and higher education institutions based on the analysis of theoretical aspects and the current system of staff motivation. To achieve the goal of scientific research, it is expedient to determine the content of concepts related to the motivation system and its components; classify motivation methods and provide their characteristics; to analyze the results of the survey regarding motivating factors of school and university teachers; to give recommendations for improving the system of staff motivation.

The novelty of this study consists in taking into account the specific features of higher and secondary education when determining the main motivating and demotivating factors, empirically establishing the degree of their importance and evaluating their significance for effective professional educational activities.

LITERATURE REVIEW

Theoretical and methodological aspects of staff motivation are of interest to many scientists now, since this process is multidimensional and requires systematic research on an integrated approach to the implementation of motivational influence on the employees' work behavior. Scientists such as L.I. Zastavniuk [6], A.V. Sokolov [7] and others, in particular N. Danylevych [8], who defined the factors and methods of how to influence motivation and considered the indicators of their effectiveness. The analysis of labor indicators as a means to research the effectiveness of the motivation mechanism was also used by V.B. Vasiuta [9]. Authors S.V. Markova [10] and L.Halan [11] revealed the content of motivation and took into account the dependence of the teachers' needs and incentives on their hierarchical position or age characteristics. Researchers [12] note that the success of organizations, educational ones as well, depends on motivation. The specifics of the motivation of the teaching staff were highlighted in the works by T.S. Kravchinska[13], L.V. Pastukh [14], A.V. Shostakovska [15], O. Yakovenko [16] who mainly concentrated on the theoretical generalization and analysis of individual approaches to motivation.

Scientific works of N.P. Bazalijs'ka [17], I.Yu. Yepifanova [18] and other Ukrainian scientists [19] dedicated to improving the motivation system, relied on material methods of encouraging staff and insufficiently considered the aspect of moral and psychological stimulation. The following studies [20] emphasized that material incentives for employees can act as investments in the development of the social capital of organizations. The issue of internal motivation was studied in a number of foreign articles [21-23], but the focus was on encouraging leadership and enthusiasm, as well as the possibility of more independent organization of an employee's work process, methods that are not always effective in educational institutions. Scientists V.V. Byba [24] and S.I. Medynska [25] considered it expedient to refer to the experience and trends of foreign countries and take into account the influence of a country's cultural factors on the choice of staff motivation methods when improving the staff motivation system.

The analysis of the recent developments shows that the views on the object of orientation of the staff motivation system differ and often rely on economic methods of stimulation. At the same time, the importance of combining material and non-material motivation methods is emphasized in the work of Ukrainian scientists [26], especially in conditions of limited opportunities for material stimulation. Studies have shown that in non-profit organizations, to which educational institutions belong, motivating factors include: the professionalism of managers, the optimal work and life balance, relationships in the team. Also, the expediency of introducing a comprehensive approach while building a motivation mechanism based on a combination of material incentives and measures aimed at increasing the morale of employees was proven by K.R. Nemashkalo [27].

Based on the analysis of literary sources, it can be noted that the issue of balancing internal and external motivation, as well as taking into account the individual characteristics of employees of educational institutions for the appropriate adjustment of the motivation system, requires a more detailed attention. It is necessary to study and practically substantiate the methods of motivation of teaching staff, which will correlate with their needs in the conditions of modern educational space.

THEORETICAL FRAMEWORK

Most organizations have their own staff motivation system and its functioning brings benefits due to the advantages of methods used in this system. However, when building such a system, it is not always possible to avoid certain shortcomings that prevent the full realization of employees' potential, since each employee has a unique set of needs, personal priorities and aspirations – the object of influence of the motivation process. Improvement of this process and the motivation system itself is one of the most important management issues, as it will foster the development of the organization in future [7, p. 79; 11, p. 6].

In a generalized sense, staff motivation is a set of driving forces of external and internal origin, which consciously or unconsciously encourage a person to perform a certain activity, giving the direction in which the goal can be reached. Motivation of work behavior is a constant and continuous process that influences the needs, aspirations, values and motives of the employee, who is expected to use efforts at a specific level of persistence and conscientiousness, with the necessary degree of perseverance [17, p. 233].

The influence of motivation on the work behavior of staff is individualized, as it depends on a number of factors. The management of each organization needs to be able not only to properly assess the direction of actions of its subordinates, but also to understand how to direct these actions to achieve goals. An effective motivation process should include motives and incentives and be based on the identification of needs that explain the work behavior of both an individual employee and the team as a whole. The listed structural elements of motivation are constantly in close relationship.

Motives are an internal driving force; perceived reasons for performing activities in a certain way (directives, desires, impulses). The motive can be based on an incentive as well as on personal reasons (a sense of responsibility and duty). Incentives are an external component of the motivation system and the reason that prompts a person to be active. The incentive can be in the form of non-material moral reward (promotion, administrative praise), but most often – in the form of material reward (bonuses, benefits, pay rise) [6, p. 169].

Speaking about the internal and external components that form the motivation system, it is necessary to distinguish between two relevant types of motivation: internal motivation and external motivation. Internal motivation throughout a person's life performs the psychological function of personal growth. It is basic and is completely derived from the interests of the individual, but for its support it needs to meet the needs for self-determination, competence and close in terms of values environment. In pedagogical activity, internal motivation is expressed in the desire to share experience and knowledge, to self-realize according to one's calling, as well as in the desire to stay and communicate in an intellectual and creative environment. External motivation is performed when work is mainly stimulated by external incentives formed under the influence of the environment, such as money, fame, power, etc. [16, p. 192-193]. Improvement of the motivation system can be achieved through a combination of different methods of staff motivation. In order to carry out the classification, scientists identified a number of features by which it was possible to group and structure a set of methods. The list of motivation methods along with their characteristics grouped by common qualification features is given in Figure 1.

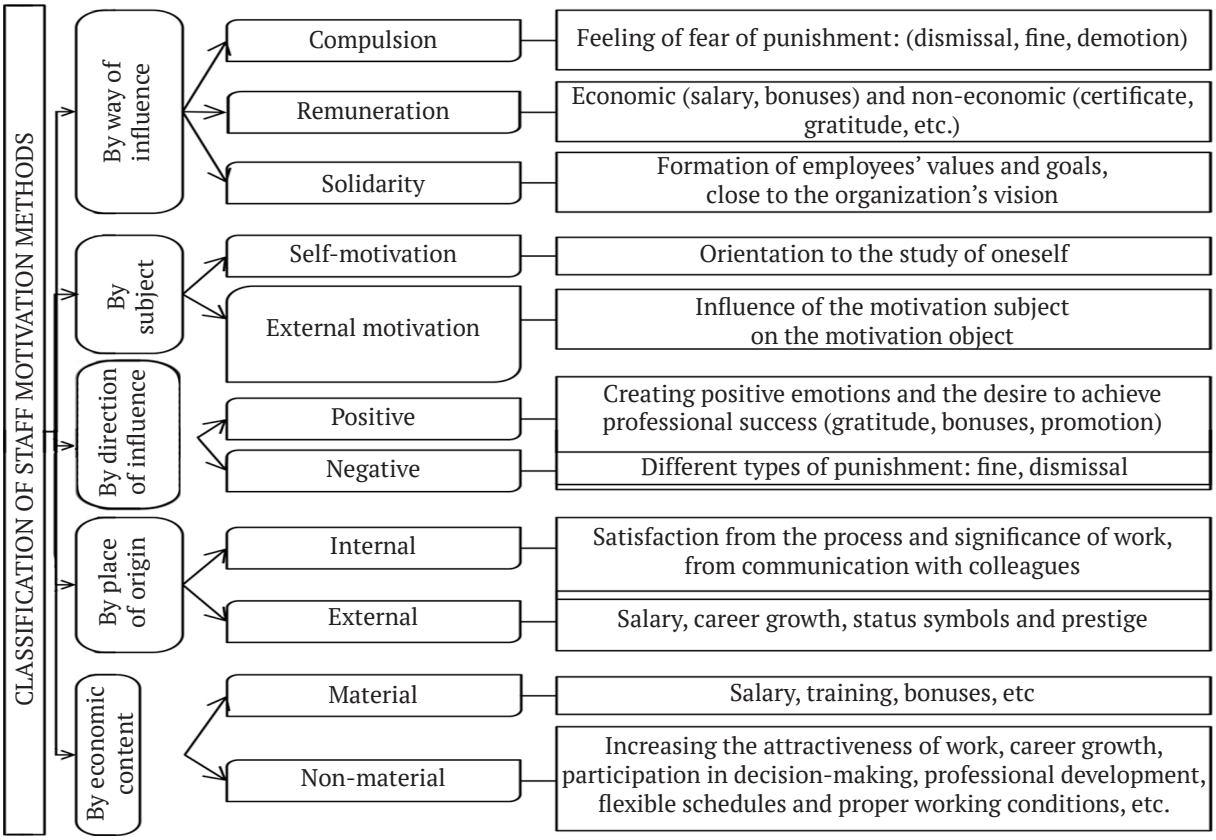

Figure 1. Features of accounting in the context of Ukraine's European integration aspirations
Source: generalized by authors based [3; 4]

It is also possible to classify by functional purpose where economic and non-economic (organizational, social and moral and psychological) methods are distinguished. The group of economic methods which mean material incentives for staff includes salary, bonuses and money rewards for achievements, necessary material assistance, tuition fees and other types of additional payments.

Organizational methods include the improvement of general working conditions and the institution itself, enrichment of work content, participation in the affairs of the organization and decision-making. Delegation of authority and motivation by prospects also belong to organizational methods. Socio-psychological methods are based on the moral and psychological impact of social relationships on a person's values and his/her own motivation. Social methods include career growth, advanced training or change of qualifications, payment of food and / or transportation costs, housing, insurance, material unemployment guarantees, etc. A group of moral and psychological methods may include support and approval (or, on the contrary, condemnation in the case of a negative direction of motivation), respect and trust, recognition of merit by management and team, the formation of a favorable socio-psychological climate in the work group. Employees can also be involved in the management of the organization [17, p. 233].

Although there is an opinion that a strong external structure of remuneration can reduce the employee's ability to respond to internal motivators, this type of incentives has short-term motivational effectiveness. If to focus on external staff stimulation, then to use them in the long run can become an expensive method of motivation as it requires a constant increase in remuneration. A more effective way to motivate staff is to provide them with both types of motivation since they are considered complementary [25, p. 65].

MATERIALS AND METHODS

To achieve the goal of the study, general scientific methods of analysis, synthesis and generalization were used, with the help of which the essence of the main concepts – motivation, needs, motives, incentives – have been revealed; the classification of motivation methods according to various characteristics has been carried out. This made it possible to generalize and substantiate the possible directions for increasing the motivation of employees of educational institutions.

To analyze the level of motivation of employees of state educational institutions, the method of comparative analysis of wages in education and wages in other areas of economic activity was used. In order to determine the role of teachers' wages on the level of their motivation, the calculated indicators of the average wages in different types of economic activity including education were compared with the average wages in the economy and with the minimum wage established in Ukraine at the legislative level. Also, changes in the number of employees by the types of economic activity in dynamics were subject to comparison.

For further analysis of the motivation of employees of state institutions, a survey of the corresponding target audience, school teachers and university teachers, was conducted. The survey method is quite universal and practical for studying the current motivation system of budgetary educational institutions. The survey was conducted in September-December 2021. It was anonymous, 161 teachers of secondary education institutions and 21 teachers of higher education institutions of the Kharkiv region took part in this survey. The survey questionnaire contained questions about the age and work experience of teachers, which made it possible to assess the relationship between the level of their motivation and these indicators. The vast majority of respondents have more than 10 years of work experience in their institution: 76.4% of school teachers and 85.7% of university teachers. The age of the respondents mostly lies within 40-54 (44.1% of school teachers and 61.9% of university teachers), and only 7 school teachers (4.3%) are between 18 and 27, and 21.1% are 55 or older. In the second place by age criterion is the range of 28-39 (30.4 and 33.3%, respectively). That is, in the surveyed educational institutions, the employees are mainly experienced, the tendency to rejuvenate the staff is not distinct. In the questionnaire, detailed attention was paid to questions related to the understanding of the motivation mechanism, which made it possible to understand the significant lack of teachers' awareness of this matter. A comparative analysis of satisfaction with the level of material motivation among secondary and higher education teachers was carried out, it revealed certain differences. The survey also included questions on determining the importance of motivating factors for employees of educational institutions. The average mathematical value for all parameters has been calculated and the main motivating and demotivating factors for teachers have been determined, the main trends for both groups of respondents have been revealed. This made it possible to obtain data on the relationship between the main motivating and demotivating factors depending on the age of teachers.

The survey method was also used to determine the specific motivation technologies employed in educational institutions. The method of logical analysis was used to identify the most and least effective technologies in the context of their impact on the level of teachers' motivation and to establish the importance of using material and non-material technologies of motivation. With the help of the ranking method, foreign motivation technologies have been ranked according to the level of their effectiveness from the point of view of teachers of Ukrainian secondary and higher education institutions.

The next stage of the study was to assess the level of motivation of employees of educational institutions when performing their functional duties and the importance of their motives as to effective professional activity. This made it possible to determine the main motives for high-quality work in education and the influence of negative methods of motivation on this work. The survey paid special attention to identifying the internal motives of employees of educational institutions. It also revealed the fact that it is important for staff to get satisfaction from the process and results of work. The purpose of the study was to determine the influence of staff motivation on work productivity of employees in special conditions such as quarantine during the coronavirus pandemic. The problems faced by school and university teachers when holding distance classes and their impact on the level of staff motivation have been identified. Also, the main reasons for the desire to change jobs have been revealed, as well as the factors that force teachers to continue performing their professional duties despite difficulties and low motivation. Graphical and tabular methods were used to visualize the results of the study.

RESULTS AND DISCUSSION

The study of the issue of staff motivation in educational institutions primarily requires an analysis of the current level of motivation of pedagogical workers at the state level, as these institutions are the most problematic area. For this, the average wages in education should be compared with the level of remuneration in other economic sectors, as well as with the average level in the economy, which in 2021 was about UAH 13,648, and the minimum wage in Ukraine, which has been UAH 6,500 since January 1, 2021. Let us also consider indicators of the number of employees working in education. Comparative analysis of statistical data in 2020-2021 [28] is given in Table 1.

Table 1. Comparative analysis of average wages and number of employees by main types of economic activity in 2020-2021

Type of economic activity	Average wages			Number of employees	
	Average wages (AW), UAH	The ratio of to the average level in the economy, %	The ratio of AW to the average level in the economy, %	The average number of employees (ANE), thousands of people	The rate of growth of the ANE in 2021 relative to 2020, %
Information and telecommunications	24 939,063	182.732	383.678	103.91	-2.21
Finance and insurance	23 312,175	170.812	358.649	170.55	-0.85
Industry	14 574,503	106.789	224.223	1 768.48	-1.56
Transport, warehousing, postal and courier activities	13 522,473	99.081	208.038	614.91	-1.73
Wholesaling and retailing; repair of motor vehicles and motorcycles	13 196,085	96.690	203.017	804.67	1.68
Agriculture, forestry and fisheries	11 724,184	85.905	180.372	400.34	-2.28
Education	11 512,471	84.353	177.115	1 154.83	-12.46
Health care and social assistance	11 294,818	82.759	173.766	801.50	-3.66
Administrative and auxiliary services	10 947,182	80.212	168.418	182.57	9.29

The types of economic activity are given in descending order of average wages. The obtained statistics demonstrate how non-competitive the wages in education are: relative to the average level in the economy, they comprise 84.35%, and relative to the minimum wage – 177%. That is, a crisis is developing in the studied industry, and one of the means to overcome it is to focus on improving the motivation system and, overall, the management of state educational institutions [15, p. 117].

If to compare the estimates of the same parameters for other types of economic activity, it is possible to come to the conclusion that it may be more financially attractive for a teacher to implement his/her practical skills and knowledge in other sectors of the economy. For example, the wage level in industry is almost 1.3 times higher, and finance and insurance generally exceed the wage level of those engaged in education by about 2 times. In addition, although the number of pedagogical workers is the second largest among the above industries, it has the largest decrease in the number of staff – by as much as 12.46%, compared to 2020. Such a difference in the assessment of professional services negatively affects the quality and pace of development of education sector in Ukraine. The conducted survey among school teachers and university teachers made it possible to obtain the following results.

When asked about the awareness of motivation system, many teachers answered that they knew about all possible incentives, although some of them assumed that certain aspects could have got past their attention (from 57.1% in universities to 77.5% in schools). But in higher education institutions there was a higher level of complete or partial ignorance of this issue – 33.3% of university teachers answered that way, while in schools the misunderstanding of motivation system is 14.3%. This can be explained by the complexity of motivation system in the conditions of a more hierarchical organization structure of universities. It is also possible to violate the principle of transparency, which must be observed for effective management of motivation [14, p. 316].

A general comparative analysis of the average wages has already demonstrated that the system of material incentives for teaching staff leaves much to be desired even at the national level, although it is impossible to ensure the effectiveness of the motivation system without a solid base of material methods. As for the satisfaction of school and university teachers with their material rewards (salary, bonuses, allowances, etc.) in the Kharkiv region, it was confirmed that these types of incentives are a problematic issue in budgetary institutions. The opinions of university teachers were equally divided, 33.3% for each group, that the material rewards either do not satisfy them at all, or hardly satisfy them, or satisfy at an average level. Among the school teachers, there were more satisfied with material rewards, but not many – less than a quarter of the respondents. The summarized results of answers to this question by school teachers are given in Figure 2.

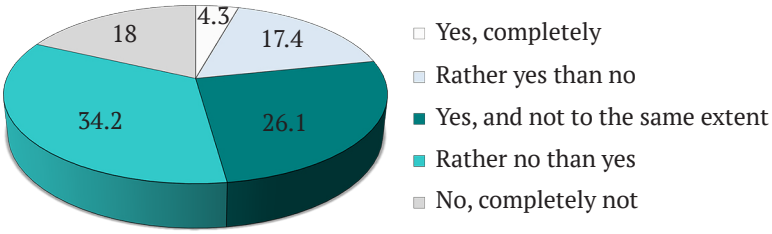

Figure 2. Teachers' satisfaction with the level of their material rewards, %
Source: made by the authors based on survey results

The free time stimulation by giving additional rest time and establishing flexible mode of work can be of practical importance [16, p. 197]. The assessments of school teachers and university teachers concerning their free time (Fig. 3) show that there is a need for this type of motivation. There are many complaints about the irregular schedule, especially among university teachers (57.14%), and 23.6% of school teachers do not always have enough time even for their own work. Only 5.6% of school teachers believe that they have enough free time. Three people even answered that rest is not important for them because work is their calling.

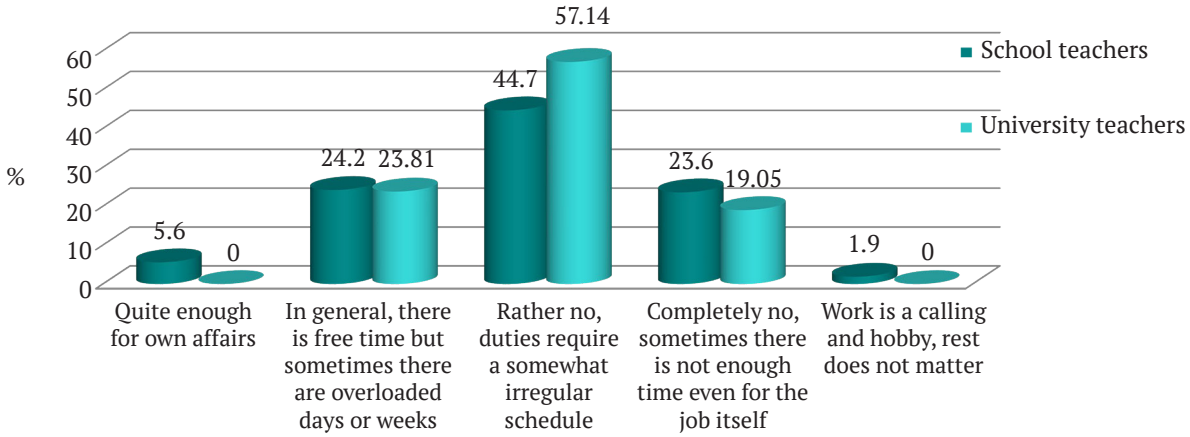

Figure 3. Assessment of free time availability made by people working in education
Source: made by the authors based on survey results

The conducted questionnaire revealed the most demotivating factors experienced by the respondents at work (Fig. 4). These include the inadequate level of remuneration, 52.2% of school teachers and 76.2% of university teachers are concerned about it, and the lack of materials and equipment: 70.8% of school teachers and 47.6% of university teachers respectively. Confirming the results of the previous question, again the problem of an irregular work schedule arises. About the same number (34.2% and 38.1%) of teachers worry about pressure and stressful working conditions. Unfavorable team atmosphere and punishment with fines, factors that were not included in the chart, do not particularly affect the motivation of both groups of teachers: less than 10% of respondents gave such answers. Several teachers complained about the excessive workload, both due to regulations and age discrimination, when a young teacher is given additional work that is not their responsibility. In addition, the large number of reports and the lack of praise from management are also demotivating.

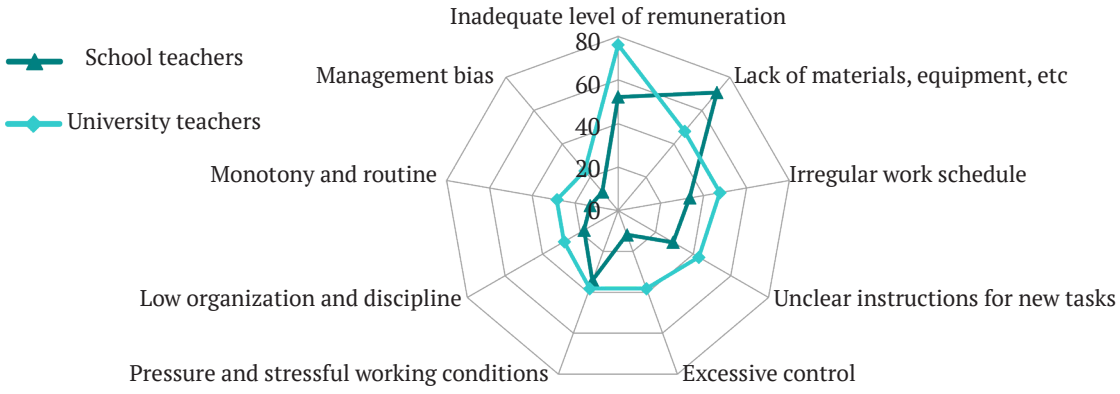

Figure 4. Demotivating factors of working in educational institutions, %
Source: made by the authors based on survey results

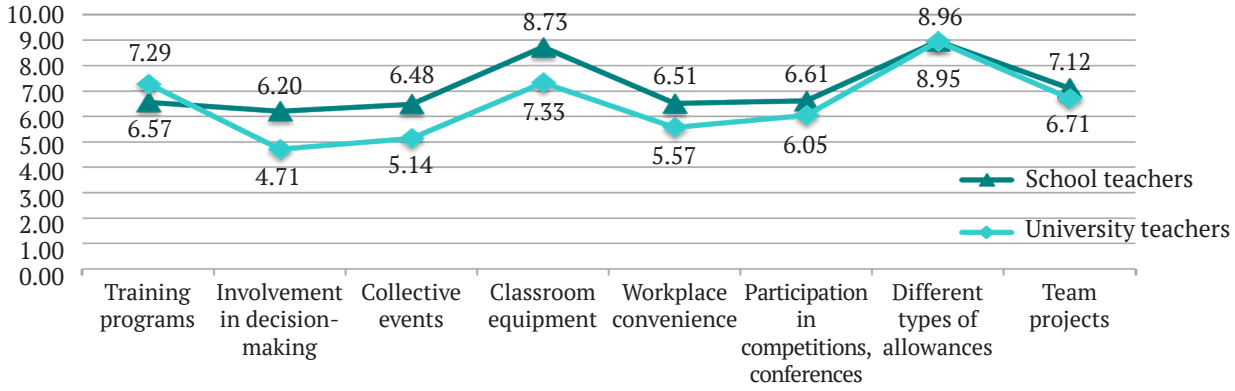

Figure 5. The importance of motivating factors for teachers with stable salary
Source: made by the authors based on survey results

By finding the average mathematical value for each parameter, it has been found out that the general trends are almost the same for both groups of respondents. The most significant motivating factors are various types of allowances (for seniority, achievements, etc.) and high-quality equipment of offices, including technical one. The provision of training and development programs is a slightly higher priority for university teachers than for school teachers. Involvement in making important decisions during meetings respondents consider to be the least important factor of motivation.

There is an opinion that the ratio of incentives and needs, on which the institution's motivation system is based, changes along with the generational changes. That is, young workers may have more innovative views and completely different needs, character and behavior [11, p. 6]. 54% of school teachers and 71.4% of university teachers agreed with this idea; and only 26.1% of school teachers and 19% of university teachers believe that all employees are equal, and there is no need to take into account these differences. Other respondents will be satisfied with any option.

Since there are not many very young and very old participants among the university teachers, a comparison of differences in the importance of motivating factors was made among school teachers. It is worth noting that the participation in decision-making, which is the least important factor for all employees, is more common for young teachers: 7.71% against the average value of 6.2%. There is a tendency towards collectivism: with an average value of collective events and meetings of 6.48%, for the younger generation it is 9%, and this factor is the second priority after allowances. Participation in competitions and conferences, as well as collective projects, have the same importance for them – 8.57%, against the average of 6.61% and 7.12%, respectively, that is, they are the third most important. It should be noted that there is a large gap in the importance of amenities in the workplace (a coffee machine, cookies) for the old generation: 4.85% against the average of 6.51%. So, the difference in mentality in different age groups is observed and this should be taken into account when improving the motivation system. Among the motivation technologies that can be used in educational institutions, school teachers noted the importance of free time motivation (51.6%) while university teachers chose the grade pay system (57.1%), according to which the reward depends on the hierarchical level, the position and individual performance (28.6%), i.e., the form of remuneration and its size depend on group or individual differences in fulfilling the duties. In secondary education institutions, the value of these technologies, as well as the KPI system (the formation of quantitative indicators of the achieved results and strategic goals, based on which the employee either receives a reward or not) is within 21-24.5%.

Pay-for-performance, the grade pay system and KPI system are material motivation technologies that are often used in foreign organizations. Free time motivation belongs to non-material technologies, as well as opportunities for career growth and corporate competitions (recognition of special successes at work; for example, "Best department of the year", "Best employee of the institution", etc.), they are not common in Ukrainian institutions: up to 17.5% for both groups of respondents. The improvement of the compensation package is a combined technology that may include payment for mobile communication services, meals, travel compensation, additional travel expenses, financing of sanatorium-resort vacations, etc. [29, p. 105-106]. It was designated by 10.6% of school teachers.

School and university teachers were asked to rate on a 1 to 5 scale how much effective they consider the above motivation technologies. As before, average mathematical values were found for both groups, the results are shown in Figure 6. Corporate contests, as can be seen from the chart, are not regarded positively by respondents, as well as the grade pay system. University teachers rated high the technologies that are currently the least common for them: opportunities for career growth, free time motivation, and improvement of the compensation package. For school teachers, non-material motivation technologies also seem to be the most attractive, with the KPI and P-f-P systems to follow.

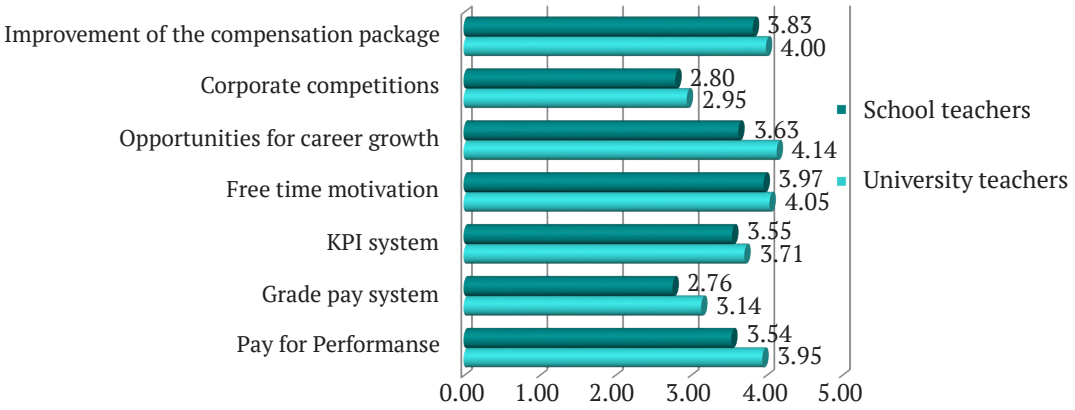

Figure 6. Effectiveness of foreign motivation technologies from the point of view of Ukrainian school and university teachers

Source: made by the authors based on survey results

The study also helped to determine the level of motivation of teachers to perform their functional duties. Among the school teachers, there were 14.3% of fully motivated employees, not only materially, but also psychologically, and 29.2% of people who are mostly satisfied with everything, but there are certain gaps in the motivation system. Only 12.4% claim that many of their needs are ignored by the management, and 11.8% of school teachers have practically no motivation: they work to satisfy their basic needs. And 32.3% are half motivated. The situation is somewhat more critical among university teachers: 38.1% are half satisfied, 23.8% do not pay attention to most needs, and 38.1% work to satisfy basic needs. There is no more positive answer among this group of respondents.

School and university teachers also assessed the importance of their motives for effective professional activity. The average mathematical values are shown in Figure 7. As with the evaluation of motivating factors, the general trends are the same for both groups of respondents. Money earnings and job satisfaction have the strongest influence on their work productivity. The ability to fully realize themselves in the profession is also important, although the desire for career growth is of little importance. It is interesting that criticism and punishment do not bother teachers too much – perhaps the methods of negative motivation are not too common in educational institutions, which is a positive sign.

It was proposed to respond to statements aimed at identifying the internal motives of the individual (Table 2).

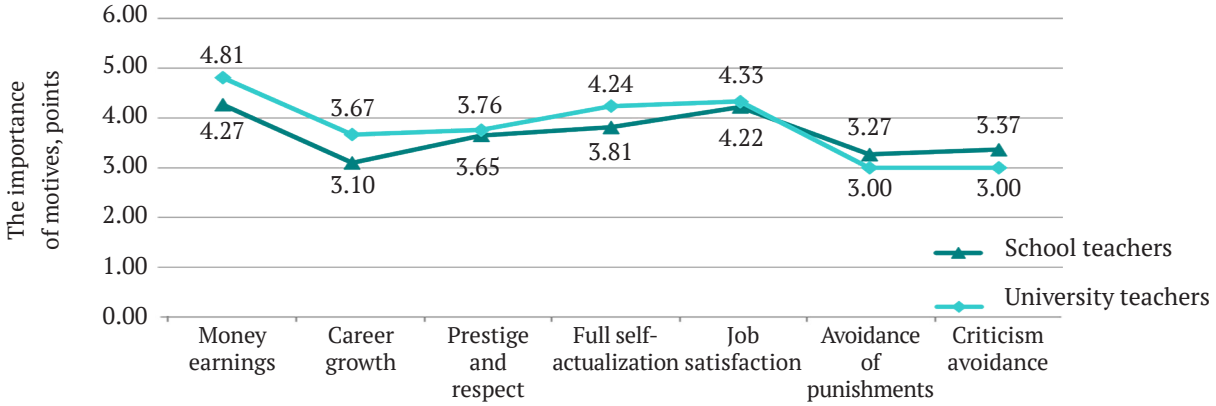

Figure 7. Significance of motives for effective professional activity in education

Source: made by the authors based on survey results

Table 2. Statements to identify internal motives

Statements	Average degree of agreement with the statements, %	
	School teachers	University teachers
My efforts are fairly rewarded	34.84	24.19
In my work, I am interested in self-improvement and professional development	67.27	62.10
I like the sense of responsibility and the ability to give orders	45.96	45.38
Working with interesting projects, people and tasks gives me inspiration	66.35	59.67
In my work, I highly value the opportunity to communicate with various people	67.76	59.67

Table 2, Continued

Statements	Average degree of agreement with the statements, %	
	School teachers	University teachers
A new level of difficulty makes me work more efficiently and persistently	59.58	59.62
I need approval from management, recognition of my achievements	59.12	53.71
Tension in the team puts pressure on me: I strive for harmony in relationships with colleagues	58.52	57.24

The received answers confirm the previously mentioned importance of satisfaction with the process and the result of work. It is expressed in inspiration from working on interesting projects, as well as cooperation and communication with various people. A significant motive for teachers is the interest in professional development. The material component is again presented negatively, since both groups are equally dissatisfied with the pay for their efforts. Responsibility and the opportunity to manage others are also perceived not very positively.

Motivation and labor productivity while organizing distance learning in quarantine conditions are also a relevant issue. Although 41.3% of school teachers and 38.1% of university teachers noted that nothing had changed for them, some respondents claim that distance work has even had a positive effect on them, as it saves travel time and gets rid of unnecessary communication that often occurred offline. However, there were many more complaints related to the loss of free time due to increased workload and the need to be constantly in touch. Not the last problem was the difficulties with technical equipment for both teachers and students, the lack of a resource base from management, due to which it was necessary to independently master complex technologies.

Achievements completely disappeared from the view of management, and the question of unfair pay among school teachers became acute: not everyone performed the same amount of work, although they received the same salary. The decrease in motivation among pupils and students also occurs, since the understanding of the usefulness of their work and, consequently, the satisfaction from it disappear. Also, teachers are increasingly concerned about physiological problems, namely eye or back problems, which arise due to long hours spent in front of the computer. Some of them developed chronic diseases during their work and earlier.

Given all the problems with staff motivation, about 80% of university teachers could have thoughts about changing jobs. The situation with school teachers is better: 2/3 of school teachers want to stay there. However, a significant part of them retains as it is difficult to change jobs due to the age and place of residence; responsibility for their choice of profession; years spent in their workplace and team; a sense of duty to their families and/or pupils or students; love for their work. But an irregular schedule with an increased amount of work, in particular for the youngest employees, unfair pay, a low level of organization of the work process and technical equipment, a consumerist attitude towards teachers on the part of children and parents make them think about leaving the job. Common reasons for changing jobs include the biased attitudes and too much control and demandingness on the part of the management, as well as the lack of prospects to adequately provide for the future of their children.

This study differs from the previous ones [8; 17; 18] in its emphasis on determining the main motivating and demotivating factors for teachers of secondary and higher education institutions, since the profession of a teacher, compared to others, has specific features that significantly affect the motivation system. In contrast to the works [4; 6], this study, in addition to theoretical provisions, is based on the empirical establishment of the degree of importance of the selected motivating factors for school and university teachers.

Compared to the results obtained in works [5; 15; 16], this study has expanded the list of motivating factors and determined their importance under the conditions of stable salary, has analyzed the effectiveness of foreign motivation technologies from the point of view of Ukrainian school and university teachers, has assessed the significance of motives for effective professional educational activity.

CONCLUSIONS

An improved motivation system should be provided with internal and external methods of motivation, which will increase its effectiveness. Analysis of the current system of motivation of secondary and higher education institutions of the Kharkiv region has revealed a significant level of dissatisfaction with material incentives, especially among university teachers. The problem of unfair remuneration is also observed at the state level, due to which the number of people working in education is also decreasing. The motivation of university teachers is also worse because they have more unsatisfied needs than school teachers.

Other most common problems in the motivation of both groups of teachers are irregular working hours, especially in the conditions of distance learning, which exacerbates the need for free time motivation, and lack of technical support. Such working conditions, in turn, increase pressure and stress at work, which negatively affect labor productivity. A significant decrease in live communication and feedback from pupils and students can cause a burnout effect, because the teacher does not get satisfaction from the results of his/her activity, though it is one of the most important internal motives of the individual.

In addition to the above, the lack of praise from management and its biased attitude, especially towards young staff, are considered demotivating factors. The younger generation is more interested in collective cooperation and participation in competitions and conferences and this determines the expediency of taking into account the difference in mentality of generations when improving the staff motivation system. But this interest is often extinguished by the fact that new employees are loaded with responsibilities that are not part of their authority, so it is important not to go to extremes and discuss this type of motivation with each employee individually.

Therefore, when improving the current system of motivation of Ukrainian secondary and higher education institutions, first of all, attention should be paid to the regulation of work volumes by optimizing distance technologies and bureaucratic processes, which will allow increasing the amount of free time and reducing the complexity of work efforts. It is considered expedient to concentrate on methods of non-material motivation taking into account age characteristics, since the material reward in budgetary organizations depends little on the local authorities. Prospects for further research are the improvement of motivation methods of educational staff in the conditions of distance learning and a more detailed analysis of the internal motivation of younger generations.

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Методи вдосконалення системи мотивації персоналу навчальних закладів

Ірина Миколаївна Чмутова, Ольга Миколаївна Миронова, Ірина Сергіївна Бихун

Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна

Анотація. Мотивація персоналу є однією з нагальних питань в управлінні організаціями будь-якої сфери діяльності. Це стосується й сфери освіти, оскільки діяльність працівників закладів освіти має вплив на якість освітніх послуг та в подальшому на розвиток держави. Тому адміністрації освітніх закладів необхідно приділяти мотивації персоналу особливу увагу. Метою статті є визначення методів вдосконалення системи мотивації та досягнення балансу внутрішньої та зовнішньої мотивації персоналу середніх і вищих навчальних закладів, що дасть змогу активізувати продуктивність праці та забезпечити галузь освіти висококваліфікованими фахівцями, максимізувавши ефективність їхніх теоретичних знань і професійних навичок. З використанням методів аналізу, синтезу та узагальнення було розкрито сутність основних понять системи мотивації та здійснено класифікацію мотиваційних методів. На основі компаративного методу виконано аналіз рівня середньої заробітної плати галузі освіти в Україні та чисельності її працівників відносно інших видів економічної діяльності, який засвідчив розвиток кризи та загальну фінансову непривабливість досліджуваної сфери. З застосуванням методу опитування проведено анкетування серед працівників закладів вищої та середньої освіти Харківської області щодо визначення їхніх мотиваційних чинників. Виявлено проблеми в задоволенні потреб економічного та соціально-психологічного характеру: значно знижується забезпечення потреби у відчутті задоволення від процесу та результату роботи через низьку віддачу учнів і студентів. Обґрунтовано важливість урахування різниці менталітету поколінь в розумінні їх внутрішніх мотивів. Доведена необхідність оптимізувати бюрократичні процеси та технології, що використовуються в дистанційній роботі. Використання отриманих результатів управлінським персоналом навчальних закладів дозволить знизити вплив демотивуючих чинників, таких як несправедлива оплата праці, брак вільного часу, стресові умови роботи, на загальний рівень мотивації персоналу, а також покращити систему мотивації закладів середньої та вищої освіти

Ключові слова: мотивація працівників закладів освіти, методи мотивації, мотивуючі та демотивуючі чинники, заклади вищої та середньої освіти, вчителі закладів середньої освіти, викладачі закладів вищої освіти

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E-mail: info@devma.com.ua
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