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SIMULATION OF THE IMPACT OF ECONOMIC DEVELOPMENT ON SOCIAL DEVELOPMENT OF THE COUNTRY

Abstract. In the current conditions of development of the international and national economy, an important task of statistical research is to conduct an objective and timely assessment and modeling of the relationship between indicators of economic and social development. Based on the results of these studies, reasonable management influences of the state on the adjustment and regulation of the country's development are accepted. The article is devoted to the study of the relationship between the main components of economic and social development of the country and the construction of a set of models for forecasting the prospects of the country. The object of the study is the socio-economic condition of the country. The article proposes an algorithmic model for assessing the impact of economic development on society, which allows to identify key economic indicators that influence and shape the social development of the country. The practical value of the algorithmic model is to develop a system of evaluation and selection as a result of modeling the most significant factors that shape the social development of the country. The study confirmed the hypothesis of the dominant impact of economic development on society and determined that the main economic factors are the level of competencies that satisfy the modern labour market, technical development of businesses and their competitiveness in markets.

Keywords: socio-economic development, integrated indicator, country competitiveness index, human development index, regression model, development trend.

JEL Classification: C15; C82; O11, O15

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МОДЕЛЮВАННЯ ВПЛИВУ ЕКОНОМІЧНОГО РОЗВИТКУ НА СОЦІАЛЬНИЙ РОЗВИТОК КРАЇНИ

Анотація. В сучасних умовах розвитку міжнародної та національної економіки важливим завданням статистичних досліджень є проведення об'єктивного та своєчасного оцінювання й моделювання взаємозв'язків між індикаторами економічного та соціального розвитку. На підставі результатів даних досліджень приймаються обґрунтовані управлінські впливи держави на коректування та регулювання розвитку країни. Стаття присвячена дослідженню взаємозв'язку між основними складовими економічного та соціального розвитку країни та побудові комплексу моделей прогнозування перспектив розвитку країни. Об'єктом дослідження виступає соціально-економічний стан країни. В статті запропоновано алгоритмічну модель оцінювання впливу економічного розвитку на соціум, що дозволяє виділити ключові економічні індикатори, які впливають й формують соціальний розвиток країни. Практична цінність алгоритмічної моделі полягає у розробці системи оцінювання й виділення в результаті моделювання найбільш значущих факторів, що формують соціальний розвиток країни. В результаті проведеного дослідження підтверджено гіпотезу про домінуючий вплив економічного розвитку на соціум та визначено, що основними економічними факторами впливу є рівень компетентностей, що задовольняють сучасному ринку праці, технічний розвиток бізнес-структур та їх конкурентоспроможність на ринках.

Ключові слова: соціально-економічний розвиток, інтегральний показник, індекс конкурентоспроможності країни, індекс людського розвитку, регресійна модель, тенденція розвитку.

Introduction. At the beginning of the 21st century the determinants for the world community were the ideas of the Concept of Sustainable Development, introduced by the founders of the international public organization "Club of Rome", whose activities are aimed at analyzing the development and prediction of the future of civilization. The main reasons for the development of this concept were the dominance of the philosophy of consumption, resource-intensive technologies and global environmental problems. The general principle of the Concept of Sustainable Development is the close interaction of environmental security, growth of social production and social stability. Supporters of the Concept believe that it is impossible to ensure sustainable economic development of society by destroying the natural environment and depletion of its resources, just as it is impossible for society to maintain the necessary quality of natural habitat and social development without a strong economy, i.e. growth is closely linked to the development which includes the concept of sustainable economic development and the environment [27].

The authors of the Concept of Sustainable Development identified the difference between the concepts of "growth" and "development" and proved that the purpose of development is not only quantitative changes in indicators, but also qualitative impacts on the socio-economic system. The formation of measures for stable and sustainable growth is based on the adoption of reasonable management decisions based on analytical studies of indicators of the country's development.

Although the Concept of Sustainable Development is recommended, many governments develop their own development strategies based on a combination of four components of growth - the environment, the economy, society and the interests of future generations. Thus, in the strategy of economic growth "Economic strategy: growth through investment" proposed by the Ministry of Economic Development, Trade and Agriculture of Ukraine on February 17, 2020 [11], the country's development is proposed as a multifaceted process that includes economic growth, creation of the sector of investment and innovation economy, structural changes in the economy, increase of labor productivity, and growth of quality of life of the population. Growth and development are interrelated categories, but the primary is the development of the economy, which is the foundation for its growth and well-being in society in the long run. Therefore, determining the interconnection and modeling the impact of economic development of the country on its social development, which is a source of well-being and reduction of social tension in society, is a topical issue of scientific research.

Literature review. The study of the relationship between social and economic development was devoted to the works of such representatives of classical economic theory as A. Smith and D. Ricardo [18], who argued that the uneven distribution of material goods is an obstacle to economic growth. In their research, A. Smith, D. Ricardo, T. Malthus also mention the connection between economic growth and prosperity. Thus, T. Malthus believed that the growth rate of the population

can exceed the growth rate of life benefits and cause an increase in poverty [18]. The representatives of marginalism (L. Walras, L. Wieser) substantiated the concept of income distribution based on marginal utility; Keynesians proved the need for state intervention in income regulation and the creation of effective public demand; Marxists believed that it was wages that provided a decent standard of living for the economy and society.

Many studies by both foreign and Ukrainian scientists have been devoted to understanding the essence of the definitions of "development" and "growth". Thus, the modern understanding of economic growth was introduced into scientific circulation by the American economist, Nobel Prize winner S. Kuznets [36], who understood economic growth as a long-term increase in opportunities to meet the diverse needs of the population through economic performance. R. Akoff [1] noted that growth is an increase in size or number, and development is a process in which the ability to satisfy their desires and the desires of others, which is determined by the internal characteristics of the object, its potential and abilities; V. Alexandrov [2] defined that the fundamental difference between development and growth is a qualitative change in the state, which occurs abruptly; J. Schumpeter [34] noted that growth does not always determine development, because growth is associated with quantitative changes over time, and development is a positive innovation changes in production, products, services, management, economy and society as a whole.

The authors [28] note that the development of the organization occurs in the process of interaction of two mechanisms - the decision-making mechanism and the spontaneous mechanism of mass innovative behaviour. That is, development can be either planned and consciously directed, or regulated spontaneously.

According to the wording of L.G. Melnik [26] the development of the system is considered as a result of the synergetic effect of such properties of the system as irreversibility, direction and regularity; O.V. Rayevnyeva [29] notes that development is a unique process of transformation of an open system in space and time, which is characterized by a permanent change in the global goals of its existence through the formation of a new dissipative structure and its transfer to a new attraction of functioning; N.V. Copa [6] under the development understands the directed, natural change in the state of the object, which is characterized by the quality of preservation and growth of the quality of functioning above the safety threshold, the growth of the quality of functioning not lower than economic growth.

Problems of social development are also in the centre of attention of scientists. Among foreign researchers of this issue, attention is paid to the works of M. Lorentz [21], H. Dalton [9], A. Atkinson [3], F. Cowell [7], S. Yitzhak [35], A. Dayton [10] and other scientists who substantiated the scientific and methodological foundations of the study of income differentiation as an economic factor that determines the foundations of further social development of society. The works of many

national scientists are devoted to the analysis of the current state of living and its dependence on economic factors, methodological aspects of research and modeling of income differentiation. Thus, E.M. Libanova, V.G. Sarioglo, V.V. Semenov [23,32] in their studies consider the statistical trends of population stratification by income at the state and regional levels, the peculiarities of the formation of household income by sources, evaluate poverty and social differentiation of the population; M.V. Makotsoba, O.V. Makarova, O.M. Gladun [22,24] emphasize the methodological aspects of calculating the human development index.

Recently, an important aspect of social development of society is the state of migration. The work of many authors is devoted to the study of trends in the change in the number of emigrants and immigrants, the factors underlying migration processes. For example, Cattaneo [5] and Kurunova [19] study migration processes in terms of understanding human behaviour as rational subjects, Czaika [8] links migration to the structure of the current and desired level of human well-being. The work of scientists [37] proposed a model of human economic behaviour, based on the decision to migrate to another region or country. Developed on the basis of the application of behavioural economics, the model takes into account such factors as profit, loss, risk, the effect of accumulation and human needs, his personal characteristics.

Despite the wide range of research on the economic development of society, social factors and effects, the issue of determining the relationship and interdependence between economic and social factors is becoming more relevant and allows us to consider the development of the country on the basis of the Concept of Sustainable Development. Many modern studies of domestic scientists are devoted to the modeling of the impact of economic development on social. Thus, Babenko V., Perevozova I., Kravchenko M., Krutko M., Babenko D. [4] consider the formation of modern processes of regional economic integration of Ukraine from the standpoint of sustainable development, ie taking into account the social and environmental components; the authors [20] propose to link the economic development of the country with the development of intellectual capital of the nation; Malyarets L., Barannyk I., Sabadash L. and Grunko R. [25] consider economic stability as a dependent category on the influence of socio-economic factors and propose to model it depending on these factors for further management of economic stability. As an inclusive development of the Ukrainian economy, researchers [15] consider the processes of economic growth and development in relation to anthropogenic pressures on the ecosystem and the nature of socio-economic transformations in society; Scientists [33] define indicative indicators for multidimensional modeling of sustainable development taking into account economic, socio-demographic, labor and environmental components, ie propose to build a monitoring system using key indicators of the concept of sustainable development.

Aims. The aim of the article is to model the social development of the country in accordance

with the interdependence and relationship with economic development trends on the basis of determining the dominant economic factors of influence and the application of the mechanism of integrated evaluation.

To achieve this goal it is necessary to solve the following tasks:

substantiation of components of social and economic development of the state;

choice of method to form integrated indicators of social and economic development of the state;

building a model of the relationship between economic and social processes of national development.

Methods. The methodological tool for identifying the impact of economic development on the social development of the country is the proposed algorithmic model, which consists of nine steps (Fig. 1).

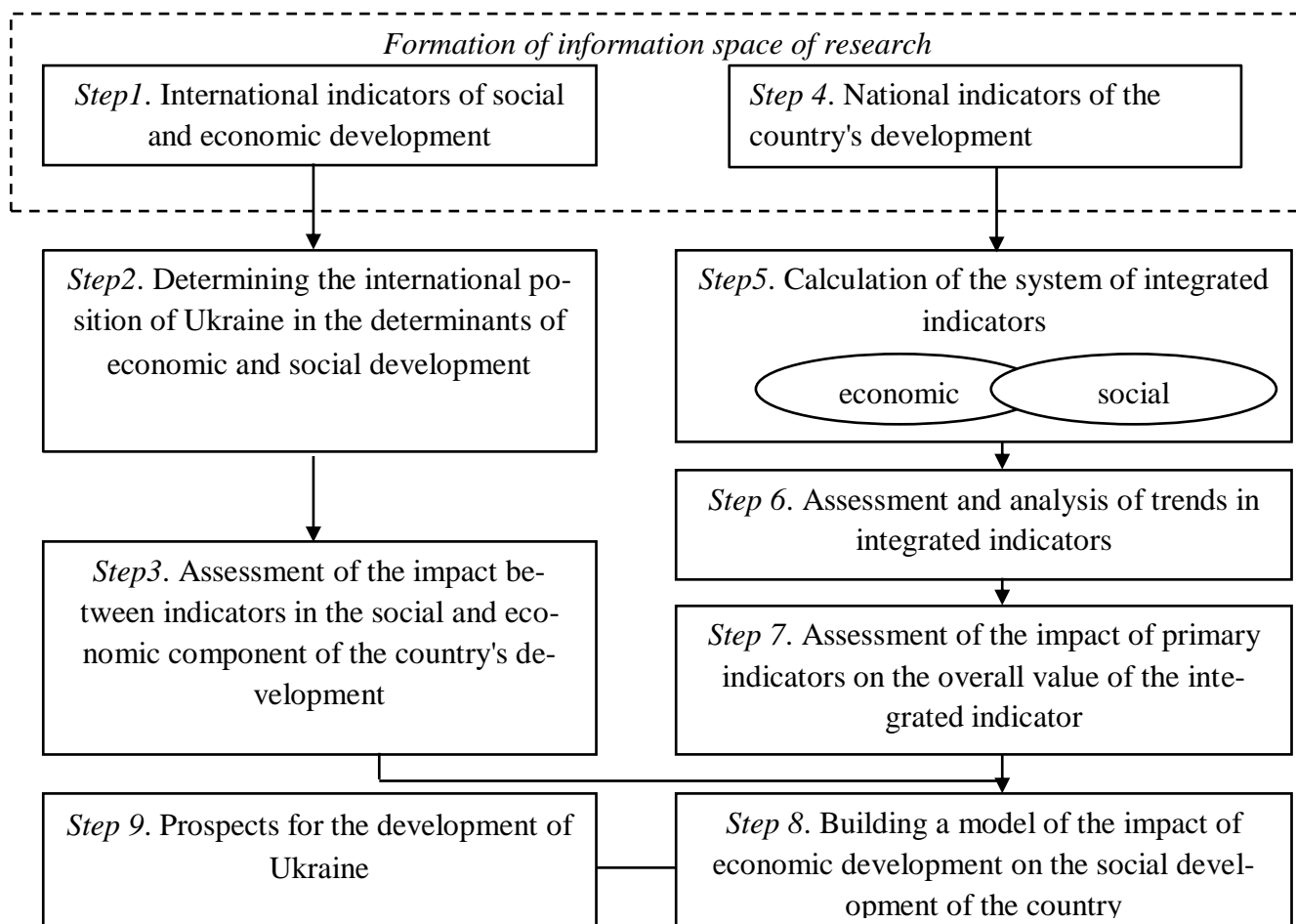


Fig. 1. Algorithmic model for assessing the impact of economic development on the social development of the country

Source: compiled by the authors on the basis of the study of economic and social phenomena

Let's consider the essence of each of the proposed steps of the algorithmic model.

Step 1. International indicators of social and economic development. The purpose of this step is to form a list of indicators that reflect the social and economic development of the country.

The characteristics of the tasks of the first step of the algorithmic model are given in Annex A1, table A1.1.

The choice of indicators in the study was based on the following statements:

economic development of any state in the 21st century is associated with the introduction of scientific and technological progress;

the social development of the state is a key component of the well-being and health of the nation;

indicators of socio-economic development of the country are interconnected and mutually substantiate each other.

Step 2. Determining the international position of Ukraine in the determinants of economic and social development. The purpose of this step is to study the development trends of international indicators and determine the country's international position in the world ratings. The characteristics of the tasks of the second step of the algorithmic model are given in Annex A1, table A1.1.

Step 3. Assessment of the impact between indicators of social and economic components of the country's development. The purpose of this step is to assess the impact of the international indicator of economic and social development of the country. This step provides for the solution of tasks, the characteristics of which are given in Annex A1, table A1.1.

The result of the evaluation is the selection of indicators that most fully characterize the economic and social development of the country. The choice of indicators was made on the basis of coefficient and pairwise correlation, which characterizes the closeness of the relationship between the relevant variables, provided that others also change their values with them.

Based on selection criteria of product indicators, the closeness of the relationship [27,29] between the indicators of economic and social development, respectively, is revealed.

In the study as influential are selected those indicators whose value of the pairwise correlation coefficient exceeds 0.7.

Step 4. National indicators of the country's development. The purpose of this step is to form a reasonable list of national indicators that reflect the economic and social development of the country. Within the framework of this step the tasks presented in Annex A1 (table A1.1) are solved.

Step 5. Calculation of the system of integrated indicators. The purpose of this step is to build general indicators of national development of the country by economic and social components. Within the limits of this step the tasks which characteristic is presented in Annex A1 (table A1.1) are solved.

The choice of the method of the level of development in the construction of an integrated

indicator is made due to the following reasons: taxonomic indicator of the level of development is adapted for complex socio-economic research, calculated on the basis of comparing the relevant indicators with the reference ones with division of the indications into stimulators and destimulators (vector P_0), gives balanced and the most objective integrated assessment in comparison with other methods of reducing partial indicators to an integrated [27].

Step 6. Assessment and analysis of trends in integrated indicators. The purpose of this step is to identify stages of decline and increase in the dynamics of general economic and general social development of the country. The characteristics of the tasks of this step are presented in Annex A1, table A1.1.

Step 7. Assessment of the impact of primary indicators on the overall value of the integrated indicator. The purpose of this step is to determine the hierarchy of influence of each of the system of primary indicators on the overall value of the integrated indicator of economic and social development of the country, respectively. The Characteristics of the tasks to be solved in this step are presented in Annex A1, table A1.1.

Step 8. Development of economic and mathematical model of the impact of economic development on the social development of the country. The purpose of this step is to substantiate the appropriate type of function and build a mathematical model that reflects the impact of economic development on the social one. The characteristics of the tasks to be solved in this step are presented in Annex A1, table A1.1.

It should be noted that in this step, mathematical models are understood as a model of the form $y = f(x)$, which will describe the real process and identify the relationship between economic and social development in the country.

Step 9. Prospects for the development of Ukraine. The purpose of this step is to identify promising trends in Ukraine depending on the changes in trends of economic and social development. To achieve this, it is necessary to solve the problem, the characteristics of which are presented in Annex A1, table A1.1.

Thus, considering the interdependence and mutual influence of the social and economic spheres of the country's development, we must prove the hypothesis that the economic component in this pair is the source which determines the state of social development. The economic situation is the basis for the development of all other areas because in the absence of economic opportunities to meet basic physiological needs (food, a roof over your head, etc.) a person is not interested in and is unable to develop in other areas.

Results. *Step 1.* International organizations assess the degree of social and economic development of countries on universal integrated indicators. The indicator of economic development is the Competitiveness index, the indicators of social development - the index of social

progress (ISP) and the index of human development (HDI), respectively.

The Competitiveness Index is based on a combination of statistics and the results of a global survey of company executives. It determines national competitiveness by analyzing 113 indicators, which are grouped into 3 sub-indices: sub-index A - basic requirements; sub-index B - efficiency boosters; sub-index C - factors of the development and innovation capital [13].

The Human Development Index (HDI) combines three indicators, namely: the development of educational potential of society (adult literacy and average duration of study); the value of real GDP (GNI) per capita and life expectancy at birth [16]. In HDI, human development and the growth of the quality of life of the population are considered as the main goal and the main indicator of economic development and social progress in general.

ISP is a combined indicator that measures the achievements of countries around the world in terms of their social development [30]. The index does not include the indicators of economic development of the world and is intended to assess the social welfare of a country. Its content consists of indicators of three groups, namely: basic human needs, the basics of human well-being, opportunities for human development. Thus, ISP can be characterized as a modification of the HDI.

Based on these thinkings, the current study will analyze the international position of Ukraine in social development according to HDI and ISP, and assess the impact between indicators in the social component of development according to HDI.

Step 2. In order to determine Ukraine's position in the international economic and social development, it is necessary to analyze the existing trends in changing the country's competitiveness index. Table 1 shows the dynamics of the competitiveness index of 137 countries for the period 1990-2018 [13].

Table 1

Competitiveness indices for the period from 1990 to 2018

Country	Index in 2010	Index in 2013	Index in 2015	Index in 2018	Ranking of countries in 1990 (among 58 countries)	Ranking of countries in 2018 (among 137 countries)	Change of the country's place according to the ISP for 1990-2018
Switzerland	5.6	5.67	5.76	5.86	6	1	5
The USA	5.59	5.48	5.61	5.85	2	2	-1
Singapore	5.55	5.61	5.68	5.71	1	3	-2
The Netherlands	5.32	5.42	5.5	5.66	9	4	5
⋮							
Brazil	4.23	4.33	4.08	4.14	-	80	-
Ukraine	3.95	4.05	4.03	4.11	58	81	-23
Butane	3.56	3.73	3.8	4.1	-	82	-
⋮							

Source: compiled by authors based on of Global Competitiveness Report

Analyzing the dynamics of change in the index among the countries (Table 1) and research [14], we can say that the countries with high economic development include Switzerland, the United States, Singapore and the Netherlands. Ukraine ranks the 81st between Brazil and Bhutan. In addition, from 1990 to 2018, Ukraine lowered its rating by 23 positions. Among the most problematic factors influencing the decline in Ukraine's competitiveness index, experts noted corruption, political instability, inflation, inefficient government bureaucracy, and access to finance. In addition, the weak competitiveness of Ukraine is influenced by crime, poor public health and uneducated workers [13].

In order to identify similarities in economic and social development, it is advisable to analyze HDI. Table 2 shows trends in changing of the human development index for 189 countries. In each group of countries according to the HDI, is given the country with the maximum value of the index in 2018. [14]

Table 2

Human development indices for the period 1990-2018

Country	Index in 1990	Index in 2010	Index in 2013	Index in 2015	Index in 2018	Country ranking in 2013 by HDI (among 189 countries)	Country ranking in 2018 by HDI (among 189 countries)	Change of the country's place for HDI in 2018 compared to 2013
<i>Very high level of human development (0.800-1.000) - 62 countries</i>								
Norway	0.850	0.942	0.946	0.948	0.954	1	1	0
<i>High level of human development (0.700-0.799) - 54 countries</i>								
Serbia	0.706	0.762	0.775	0.785	0.799	67	63	4
...
Ukraine	0.705	0.732	0.744	0.742	0.750	83	88	-5
<i>The average level of human development (0.500-0.699) is 37 countries</i>								
Vietnam	0.475	0.653	0.673	0.680	0.693	117	118	-1
<i>Low level of human development (0.400-0.499) - 36 countries</i>								
Syrian Arab Republic	0.558	0.644	0.572	0.540	0.549	140	154	-14

Source: compiled by authors based on of Human Development Reports

The considered tendencies in change of HDI on the countries (table 2) show that the most prosperous country in the world, from the point of view of development of human potential, is Norway. Also, in the top five are countries such as Switzerland, Ireland, Germany and Hong Kong.

Ukraine ranks the 88th between Azerbaijan and the Dominican Republic. In addition, Ukraine has downgraded its position over the past 6 years - its rating has fallen by 5 positions. Despite this, in 2017 the country moved to a group of countries with a high level of human development.

The comparison of Ukraine and the countries that occupy the highest rank in each group for

HDI on the components of this index in 2018 are given in table 3. [16]

Table 3

Comparison of HDI components of Ukraine and the countries - representatives of each of the groups

Components of HDI and their relationship to the socio-economic situation	Ukraine (0.750)	Norway (0.954)	Serbia (0.799)	Vietnam (0.693)	Syrian Arab Republic (0.549)
Life expectancy at birth (longevity and health)	72	82.3	75.8	75.3	71.8
Expected number of years of study (knowledge)	15.1	18.1	14.8	12.7	8.9
Average number of years of study (knowledge)	11.3	12.6	11.2	8.2	5.1
GNI per capita, USD USA (decent standard of living)	7994	68059	15218	6220	2725

Source: compiled by the authors based on the analysis of the Human Development Index by country

As HDI is the average indicator of the main achievements of human development in the country, which relate to longevity and health, education and acquired knowledge and a decent standard of living, it (HDI), like all average indicators, hides the inequality of human development among the population at the level countries. As you can see from the table 3, the HDI of Ukraine in 2018 at the level of 0.750 is equal to the average value for the countries in the group of high human development and is lower than the average value for the countries with very high human development by 0.15 points. If we compare the components of HDI by country, we see that the largest gap between Ukraine and countries representing the groups of countries with very high (Norway) and high (Serbia) levels of HDI is observed in economic indicators - GNI per capita. In addition, based on 2018 data, people, who live in developed countries, can expect a 10 years longer life than in Ukraine. All this confirms the hypothesis of the impact of the economic situation on the social development of the country.

A comparison of trends in economic and social development in Ukraine on the basis of international indices is shown in Fig. 2.

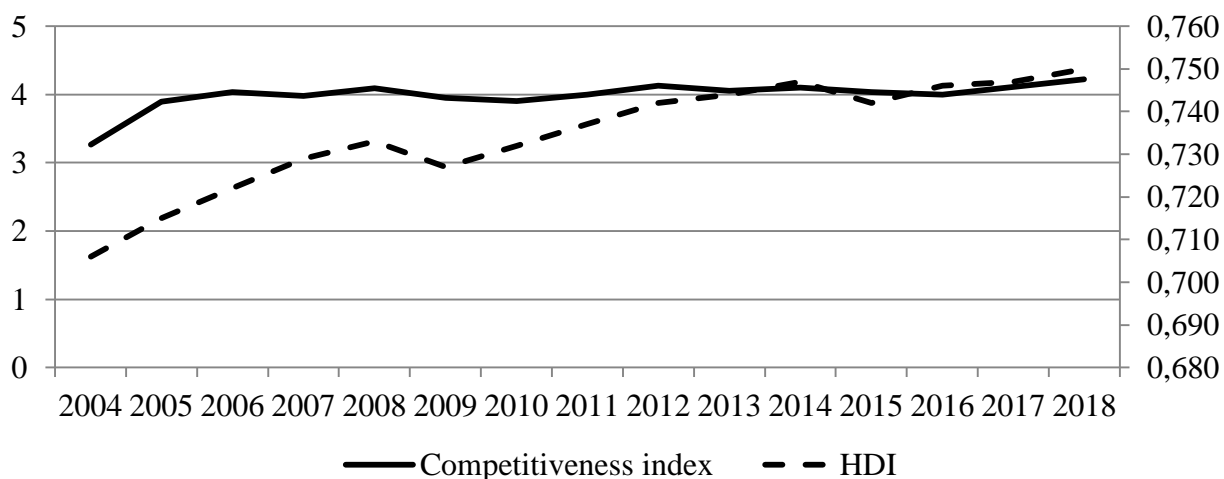


Fig. 2. Trends in Ukraine's position on the competitiveness index and HDI

Source: built by authors on the basis of research

The analysis of economic and social development of Ukraine on the basis of international indicators shows that there is a direct relationship and mutual influence of the economic situation on the level of social development. As can be seen from Fig. 2, the HDI for the period 2004-2012 was lower than the competitiveness index, but had a tendency to increase significantly. This testifies to the efforts of the state aimed at strengthening social well-being in society. In general, during the analyzed period, trends in competitiveness indices and HDI are closely correlated and unidirectional.

Step 3. To assess the impact between the components of HDI in Ukraine (life duration, life expectancy, average number of years of study and GNI per capita), a correlation matrix was constructed (Annex A2, Fig. A2.1). According to the results of this matrix, the following rating of component impact was obtained: the strongest impact on HDI is exerted by the GNI per capita and the expected duration of study ($r = 0.97$); then the average number of years of study ($r = 0.9$) and life expectancy ($r = 0.87$).

In Annex A2, Fig. A2.2 shows the correlation matrix between the 12 components of the competitiveness index. The greatest influence on the competitiveness index is exerted by the indicators of companies' competitiveness ($r = 0.72$), the level of technological development ($r = 0.69$) and higher education and training ($r = 0.59$). This confirms the fact that a country cannot be competitive if companies have low competitive advantages and knowledgeable staff.

Analyzing the correlation matrices of the components of international indices, we can once again confirm the hypothesis of the impact of economic development on the social one. Thus, the correlation between GNI per capita and the duration of training is 0.95.

Step 4. Based on the statements formulated in this study, the indicators that characterize economic development are: innovation and investment, GDP per capita, indicators of export-import

activity of the country, the profitability of the population as a share of wages in GDP.

The following indicators were selected as social indicators: the state of the demographic situation, and the birth rate itself (Kbirth r.); the level of life satisfaction and social tension, namely the migration growth rate (Kmigr. gr. r.) and the unemployment rate (Kunem. r); education and comfort of life, namely the number of graduates from universities (Number grad.) and the level of crime (Kcrime); health, namely, the primary morbidity rate (Kpr. morb. r.).

Step 5. Separately, according to economic and social indicators of development, using the method of the level of development, the integrated indicators of economic (IIED) and social (IISD) development of Ukraine for the period 1990-2018 were calculated [11]. Figure 4 shows the comparative dynamics of these integrated indicators.

Step 6. Analyzing the trends of change in IIED of Ukraine (Fig. 3), we can identify the following stages: the decline in the level of economic development of the country was observed during the periods 1991-2000 and 2008-2016; and the stage of increase was in the period 2001-2007 and is observed from 2017 to the present.

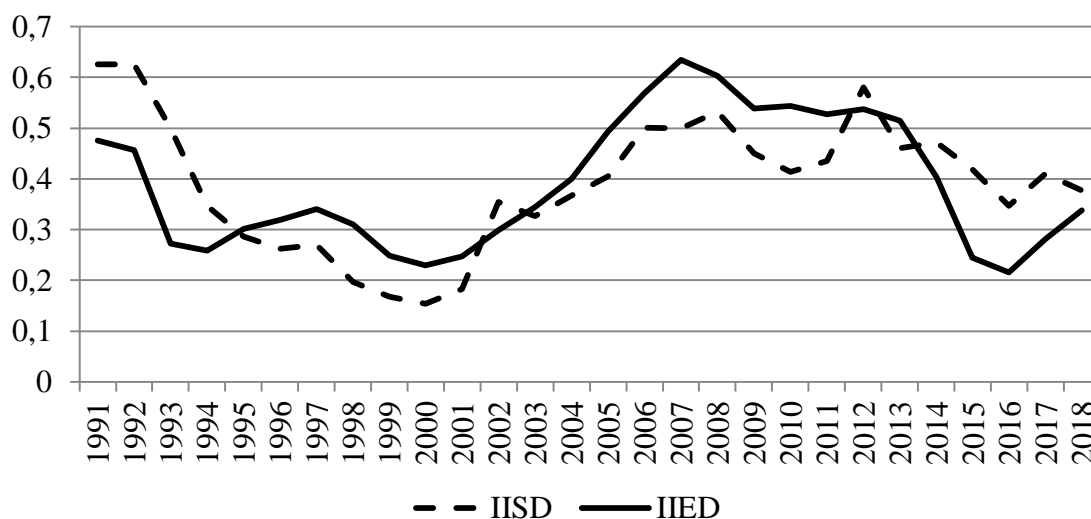


Fig. 3. Dynamics of integrated indicators of economic and social development of Ukraine for the period 1990-2018

Source: built by authors on the basis of research

The analysis of trends in the dynamics of the IISD (Fig. 4) allows us to identify the following stages in the social development of Ukraine: the decline in the level of social development of the country occurred in the period 1991-2000, 2008-2010, and increase - in 2001-2008, 2011 -2012, starting from 2013, unfortunately, there has been a tendency to reduce the welfare of the nation.

Comparing the trends of changing integrated indicators of economic and social development, we can speak of identical dynamics. The periods of decline in the integrated indicators of economic and social development of the country fall on the periods of restructuring of the national economy

and global financial and economic crises, and the years when there was an increase in social development in the country are associated with improving the economic situation. At the same time, it can be noted that during the periods of the most stable economic development of the country (the trend after the collapse of the USSR (until 1994), 2002-2003, 2012), the level of social development was higher than economic one; that again confirms its dependence of the society development on economic factors.

Step 7. To assess the impact of primary indicators on the overall value of integrated indicators of economic and social development, the results of correlation analysis were used (Annex A3, Fig. A3.1, A3.2). Some statistical material [11] for the period 1991-2018 was used for the analysis.

The analysis of correlations allowed to draw the following conclusions:

1) the closest direct relationship of IISD is observed with indicators of migration growth ($R = 0.895$), birth rate ($R = 0.861$) and feedback with the unemployment rate ($R = -0.709$), i.e. these indicators have the greatest impact on the level of the social development of the country;

2) there is a close connection between IIED and all the indicators, except for the number of organizations that perform research. Thus, the selected indicators have the most significant impact on the level of economic development of the country, and the greatest impact is exerted by the indicator of capital investment ($R = 0.851$).

Step 8. As the research has confirmed that economic development has an impact on social development, to form effective management decisions on government regulation of social development of society, it is proposed to analyze which of the partial economic indicators have the most significant impact on HDI. Analyzing the values of the correlation coefficients of the partial indicators of IIED (Annex A3, Fig. A3.2), the multicollinear relation of the GDP indicator with other indicators was determined. For these reasons, this indicator was removed from the list of exogenous factors of the model. The results of model construction are presented in Annex A3, table A.3.1.

Thus, the economic-mathematical model of the influence of economic factors on the social development of the country has the form:

$$\mathbf{IISD = 0.533 + 0.008 \times X1 + 0.012 \times X3 - 0.014 \times X4 + 0.015 \times X5 - 0.0005 \times X6.}$$

Checking the model for adequacy (coefficient of determination is 0.814) allows us to draw conclusions about the possibility of using the developed model to predict the development of social processes in society.

In order to analyze how the social development of the country will change in the future under the influence of economic factors, we will determine the future values of each of the analyzed

indicators. The results of forecasting by economic factors and assessing the quality of models are presented in table 4.

Table 4

Complex of models and forecast values of economic indicators

Indicator	Model type	Coefficient of determination	Predictive value			
			2019	2020	2021	2022
The share of wages in GDP (X1), %	$y = 2E-05x^6 - 0.0015x^5 + 0.0519x^4 - 0.8474x^3 + 6.9662x^2 - 26.407x + 78.758$	0.78	41.64	41.47	41.40	41.64
Export (X3), billion USA	$y = 3E-05x^6 - 0.0021x^5 + 0.0585x^4 - 0.7357x^3 + 4.3491x^2 - 11.327x + 29.498$	0.92	70.43	72.45	74.47	76.49
Imports (X4), billion USA	$y = 4E-05x^6 - 0.0029x^5 + 0.0833x^4 - 1.0493x^3 + 5.9958x^2 - 13.812x + 28.746$	0.90	80.75	83.25	85.74	88.24
Capital investments (X6), billion USA	$y = 6E-06x^6 - 0.0003x^5 + 0.0002x^4 + 0.1284x^3 - 1.6502x^2 + 4.4421x + 16.566$	0.74	24.06	24.43	24.79	25.16
Number of organizations performing research and development	$y = 0.0252x^3 - 3.0795x^2 + 52.442x + 1269$	0.96	814.56	751.11	686.04	619.49

Source: compiled by authors on the basis on models of econometric analysis

Analyzing the obtained forecast values by economic indicators, it is seen that by 2022 there will be a positive trend in almost all indicators, except for the indicator - the number of organizations that perform research and development.

Under the influence of these economic indicators, the promising trend of the integrated indicator of social development of the country will also have a dynamic to increase (Fig. 4).

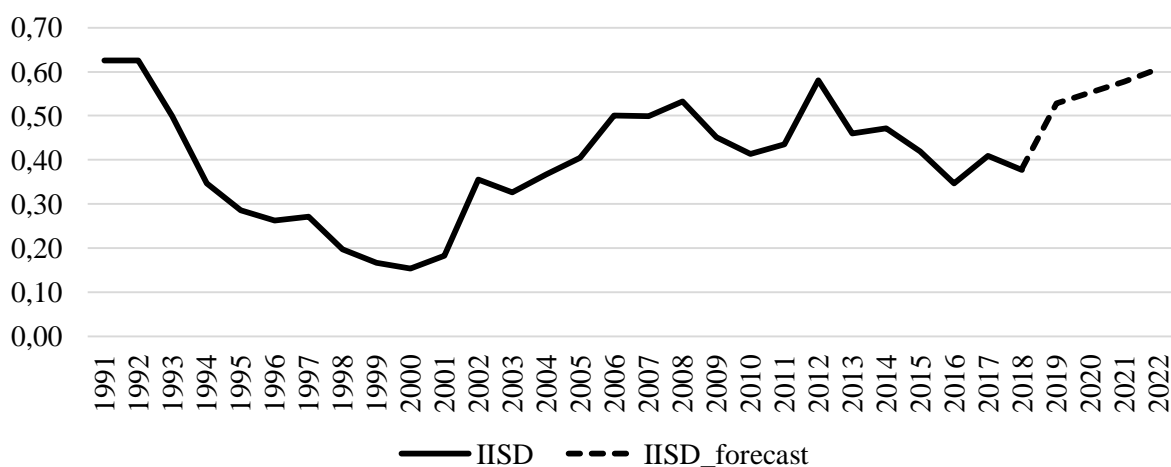


Fig. 4. Retrospective and perspective values of the general indicator of social development of the country

Source: built by authors on the basis of research

Step 9. Based on the results of economic and mathematical modeling, we can conclude that in the economic and social spheres there are the same processes, i.e. they are interrelated. In order to maintain the trend of improving the social development in Ukraine, it is necessary to:

increase the share of wages of workers because for Ukraine there is a low share of labour costs in the cost of production and wages in the structure of GDP;

create an effective legal and regulatory environment to increase exports and reduce imports because the qualitative growth of exports or changes in commodity and geographical diversity determines the redistribution of resources between industries;

develop and implement measures that motivate enterprises and organizations of various sectors of the economy to introduce new factors of production, including machinery and equipment, a new type of human capital, which is necessary for innovation and strengthening the competitive advantages of domestic producers in the international economic space;

create effective migration management programs and increase the attractiveness of the national labour market for migrant workers.

It should be noted that the obtained promising trends in the economic and social environment of the country are calculated without taking into account the consequences of the COVID-19 pandemic.

Discussion. In modern conditions, the key goals of socio-economic development are the creation of an innovative type of economy, mainly based on strengthening the social components of quality of life. Current trends in socio-economic development of any country are characterized by global instability caused by crises, which are based on such factors as global changes in the ecological condition of the Earth, a significant reduction in natural resources which slows economic growth. In these conditions, the search for ways to reduce the negative effects of the economy on social development and ways to achieve positive dynamics of social indicators is an urgent task of governments of all countries. In this regard, a necessary condition for the development of scientifically reasonable state programs of socio-economic development of the country is to conduct economic and statistical research and modeling the impact of economic factors on the development of society.

The latter requires a reasonable identification of economic factors that most strongly influence the social development of the country. In this study, this problem is proposed to be solved by assessing the correlation between selected economic and social indicators. The further research in this direction, in our opinion, should be focused on the use of morphological and cognitive analysis to build maps of the relationship between indicators with the establishment of certain weights between them. This will strengthen the validity of decisions on the management of the social

component of state development.

Further research is needed to justify the choice of the method of integral convolution. In addition, a careful research should be devoted to the choice of methods and models that should adequately approximate the behaviour of the socio-economic system in a stochastic environment caused by the effects on the economic development of the COVID-19 pandemic. But this requires reliable statistics which scientists can only get by the end of 2020.

Conclusion. Socio-economic development of the country is a process of purposeful influence on the factors that ensure the socialization of the economic system on the basis of innovative economic development. This involves identifying the dependence of social development on key indicators of economic development. The algorithmic model proposed in the study is an effective tool for identifying the impact of indicators of the integrated indicator of economic development on the integrated indicator of social development.

The study analyzes international indicators of social and economic development and identifies Ukraine's position at the international level, confirmed the hypothesis of the impact of the economic situation on the social development of the country.

To calculate the integrated indicators of economic and social development of the country at the national level, a system of indicators was formed on the basis of the statements formulated in the study and a comparative analysis of trends in the change of these integrated indicators was made. The conducted research allowed to draw a conclusion about the close correlation between the trends in the change of economic and social development during the last 28 years.

To determine the more detailed impact of indicators on the economic development of the country the method of correlation analysis was used, it resulted in the conclusion that the most significant impact on the economy have such factors as company competitiveness, technological development, higher education and training.

Based on the construction of an econometric model of the impact of reasonable economic factors on the integrated indicator of social development, a promising trend in the social sphere of the country's development is identified and recommendations for developing the state programs to support and strengthen social welfare.

Thus, ensuring sustainable development of the country should be based on achieving not only economic but also social development goals which are the key to the harmonious development of society.

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Characteristics of the step of the algorithmic model

The name of the task	Economic content	Incoming data	Tools	The results of the solution
<i>Characteristics of the first step of the algorithmic model</i>				
T.1.1. Analysis of approaches to assessing the economic and social development of the country	Selection of indicators that reflect the economic and social development of the country	Modern approaches to the system assessment of economic and social development of the country	Monographic, comparative, content analysis	The list of indicators for the study of economic and social development of the country
T.1.2. Construction of a reasonable system of international indicators for assessing the economic and social development of the country	Formation of the list of indicators of social and economic development of the country	The result of a solution T.1.1.	Monographic, comparative, content analysis	The list of indicators of the international indicator space of research of economic and social development of the country is substantiated.
<i>Characteristics of the second step of the algorithmic model</i>				
T.2.1. Study of trends in international indices that reflect the economic and social development of the country	Construction of trends of change of international indices of economic and social development of the country	Time series of world indices	Graphic method, logical and economic method	Determining trends in the indices of economic and social development of the country
T.2.2. Analysis of the world rating to assess the international position of the country	Estimation of the change of a rating place of the country on indices	Time series world ranking of countries	Logical and economic method	Determining the international position of the country
T.2.3. Comparative analysis of the trend of international indices of economic and social development of the country	Determining trends in international indices of economic and social development of the country	The result of the solution T.2.1	Comparative analysis, logical and economic analysis, graphic analysis	Determining the interrelationship and mutual influence of economic development on social one
<i>Characteristics of the third step of the algorithmic model</i>				
T.3.1. Analyze the degree of influence of each component of the international indicator of economic development of the	Determining the correlations between the components of the international index of economic development of the country	Components of the index of economic development of the country in dynamics	Correlation analysis	Identify the component that has the greatest impact on the country's international economic development index

country				
T.3.2. Analyze the degree of influence of each component of the international indicator of social development of the country	Determining the correlations between the components of the international index of social development of the country	Components of the index of social development of the country in dynamics	Correlation analysis	Identify the component that has the greatest impact on the country's international social development index
<i>Characteristics of the fourth step of the algorithmic model</i>				
T.4.1. Analysis of approaches to assessing the economic and social development of the country at the national level	Forming a list of indicators that characterize the national economic and social development of the country	Macroeconomic indicators of the country's development	Monographic, comparative, content analysis	The primary list of indicators of the country's development at the national level
T.4.2. Building a reasonable system of indicators of economic and social development of the country	Formation of an appropriate list of national indicators of the country's development	The result of the solution T.4.1.	Logical and economic analysis	The list of national indicators that characterize the economic and social development of the country is substantiated
<i>Characteristics of the fifth step of the algorithmic model</i>				
T.5.1. Comprehensive diagnosis of economic development of the country	Construction of an integrated indicator of economic development of the country	The result of the solution T.4.2.	Development level method	Determining the integrated indicator of economic development of the country and analysis of its trend
T.5.2. Comprehensive diagnosis of social development of the country	Construction of an integrated indicator of social development of the country	The result of the solution T.4.2.	Development level method	Determination of the integrated indicator of social development of the country and analysis of its tendency
<i>Characteristics of the sixth step of the algorithmic model</i>				
T.6.1. Analyze the dynamics of the overall economic development of the country	Analysis of trends in the integrated indicator of economic development of the country	The result of the solution T.5.1	Graphic method, logical and economic analysis	Highlighting the stages of growth and decline in the economic development of the country
T.6.2. Analyze the dynamics of the overall social development of the country	Analysis of trends in the integrated indicator of social development of the country	The result of the solution T.5.2	Graphic method, logical and economic analysis	Selection of stages of growth and decline in the social development of the country
T.6.3. Conduct a comparative analysis of	Comparative analysis of international and	International indicator and integrated	Graphic method, comparative	Identifying the one-way direction between international

international and national indicators of economic and social development of the country	national indicators of development	indicator of the country's development	analysis, logical and economic analysis	and national indicators of economic and social development of the country
<i>Characteristics of the seventh step of the algorithmic model</i>				
T.7.1. Assess the impact of national indicators on the integrated indicator of economic development of the country	Assessment of the impact of primary indicators on the overall value of the integrated indicator of economic development of the country	The result of the solution T.4.2. and T.5.1	Correlation analysis	Building a ranking of the values of correlation indicators in order to identify those that have the greatest impact on the economic development of the country
T.7.2. Assess the impact of national indicators on the integrated indicator of social development of the country	Assessment of the impact of primary indicators on the overall value of the integrated indicator of social development of the country	The result of the solution T.4.2. and T.5.2	Correlation analysis	Building a ranking of the values of correlation indicators in order to identify those that have the greatest impact on the social development of the country
<i>Characteristics of the eighth step of the algorithmic model</i>				
T.8.1. Building a model of influence	Determining the dependence of social development on the economic development of the country	The result of the solution T.5.1 and T.5.2	Models of econometric analysis	Determining the impact of economic development on the social development of the country
<i>Characteristics of the ninth step of the algorithmic model</i>				
T.9.1. Determining the prospects of the country's development depending on the economic and social development of the country	Modeling of perspective development of the country	The result of the solution T.8.1	Logical and economic method	Forecasting the future trajectories of economic and social development of the country

Source: compiled by authors based on of research

	1 ILR	2 Triv.gut.	3 Triv.navch.	4 Ser.triv. navch.	5 VND
1995	0,664	67,9	12,2	10	4984
2000	0,671	67,3	13	10,7	4659
2005	0,715	67,4	14,6	11,2	7173
2010	0,732	69,5	14,8	11,3	7715
2015	0,742	71,8	15	11,3	7375
2016	0,746	72	15	11,3	7593
2017	0,751	72,1	15	11,3	8130
2018	0,75	72	15,1	11,3	7994

Correlations (Spreadsheet1)					
Marked correlations are significant at p < ,05000					
N=8 (Casewise deletion of missing data)					
Variable	ILR	Triv.gut.	Triv.navch.	Ser.triv.navch.	VND
ILR	1,000000	0,865624	0,970466	0,904541	0,970366
Triv.gut.	0,865624	1,000000	0,736776	0,629669	0,760712
Triv.navch.	0,970466	0,736776	1,000000	0,974048	0,952173
Ser.triv.navch.	0,904541	0,629669	0,974048	1,000000	0,875006
VND	0,970366	0,760712	0,952173	0,875006	1,000000

Fig. A2.1. Initial data and the final correlation matrix for the components of the HDI

Source: built by authors on the basis on models of econometric analysis

Data: Spreadsheet1* (13v by 13c)														
	1 GCI	2 INS	3 INF	4 ME	5 HPE	6 HET	7 GME	8 LME	9 FMD	10 TR	11 MS	12 BS	13 INN	
2006	3,89	3,14	3,30	4,27	5,88	4,35	3,96	2,71	3,84	3,11	4,50	2,97	3,12	
2007	3,98	3,20	3,21	4,45	5,73	4,40	3,92	3,59	3,92	3,25	4,53	3,44	3,26	
2008	4,09	3,26	3,13	4,62	5,59	4,46	3,87	4,47	4,00	3,38	4,56	3,91	3,40	
2009	3,95	3,10	3,39	3,96	5,41	4,38	3,74	4,57	3,56	3,37	4,67	3,63	3,21	
2010	3,9	2,96	3,83	3,20	5,70	4,61	3,53	4,54	3,31	3,37	4,53	3,48	3,11	
2011	4	2,98	3,87	4,21	5,64	4,58	3,58	4,44	3,39	3,47	4,54	3,48	3,11	
2012	4,13	3,13	4,10	4,40	5,78	4,70	3,82	4,44	3,52	3,60	4,60	3,70	3,16	
2013	4,05	2,99	4,07	4,20	5,84	4,75	3,81	4,18	3,46	3,28	4,60	3,68	3,03	
2014	4,1	2,99	4,07	4,20	5,84	4,75	3,81	4,18	3,46	3,28	4,60	3,68	3,03	
2015	4,03	3,07	4,07	3,12	6,06	5,03	4,02	4,33	3,18	3,45	4,54	3,70	3,41	
2016	4	3,05	3,93	3,17	5,95	5,08	3,98	4,23	2,95	3,58	4,40	3,62	3,44	
2017	4,11	3,20	3,90	3,50	6,00	5,10	4,00	4,00	3,10	3,80	4,50	3,70	3,40	
2018	4,22	3,21	3,90	3,51	6,01	5,12	3,98	4,00	3,11	3,83	4,51	3,75	3,45	

Correlations (Spreadsheet1)													
Marked correlations are significant at p < ,05000													
N=13 (Casewise deletion of missing data)													
Variable	GCI	INS	INF	ME	HPE	HET	GME	LME	FMD	TR	MS	BS	INN
GCI	1,000000	0,386526	0,408011	0,054781	0,381045	0,594949	0,378177	0,253062	-0,277962	0,687825	0,061763	0,717416	0,374043
INS	0,386526	1,000000	-0,563478	0,265518	0,065230	-0,023899	0,618254	-0,312603	0,349802	0,294899	-0,121062	0,173418	0,642131
INF	0,408011	-0,563478	1,000000	-0,470671	0,539229	0,722511	-0,046725	0,374920	-0,768911	0,448688	-0,046436	0,311097	-0,127553
ME	0,054781	0,265518	-0,470671	1,000000	-0,517311	-0,701290	-0,152347	-0,210036	0,847477	-0,470904	0,485581	-0,097339	-0,447667
HPE	0,381045	0,065230	0,539229	-0,517311	1,000000	0,791969	0,675027	-0,352925	-0,575130	0,398653	-0,599078	-0,001060	0,378093
HET	0,594949	-0,023899	0,722511	-0,701290	0,791969	1,000000	0,466654	0,208702	-0,877056	0,769190	-0,467139	0,465370	0,540796
GME	0,378177	0,618254	-0,046725	-0,152347	0,675027	0,466654	1,000000	-0,475045	-0,126290	0,262861	-0,408270	0,090830	0,654190
LME	0,253062	-0,312603	0,374920	-0,210036	-0,352925	0,208702	-0,475045	1,000000	-0,323383	0,354174	0,356179	0,759330	0,069227
FMD	-0,277962	0,349802	-0,768911	0,847477	-0,575130	-0,877056	-0,126290	-0,323383	1,000000	-0,694396	0,413392	-0,268567	-0,334348
TR	0,687825	0,294899	0,448688	-0,470904	0,398653	0,769190	0,262861	0,354174	-0,694396	1,000000	-0,299128	0,542520	0,630218
MS	0,061763	-0,121062	-0,046436	0,485581	-0,599078	-0,467139	-0,408270	0,356179	0,413392	-0,299128	1,000000	0,239533	-0,519067
BS	0,717416	0,173418	0,311097	-0,097339	-0,001060	0,465370	0,090830	0,759330	-0,268567	0,542520	0,239533	1,000000	0,412081
INN	0,374043	0,642131	-0,127553	-0,447667	0,378093	0,540796	0,654190	0,069227	-0,334348	0,630218	-0,519067	0,412081	1,000000

Fig. A2.2. Initial data and the final correlation matrix for the components of the competitiveness index

Source: built by authors on the basis on models of econometric analysis

	Number grad.	Kpr. morb. r.	Kmigr. gr. r.	Kbirth r.	Kcrime	Kunem. r	IISD
Number grad.	1						
Kpr. morb. r.	0.696	1					
Kmigr. gr. r.	0.255	0.133	1				
Kbirth r.	0.276	0.045	0.728	1			
Kcrime	-0.021	-0.383	-0.384	-0.305	1		
Kunem. r	0.135	0.087	-0.496	-0.665	0.426	1	
IISD	0.304	0.124	0.895	0.861	-0.529	-0.709	1

Fig. A3.1. **Correlation matrix for indicators of the integrated indicator social development**

Source: compiled by authors on the basis on models of econometric analysis

	The share of wages in GDP (X1), %	GDP per capita (X2), US dollars	Export (X3), billion USA	Imports (X4), billion USA	Capital investments (X5), billion USA	Number of organizations performing research and development (X6)	IIED
The share of wages in GDP (X1), %	1						
GDP per capita (X2), US dollars	0.297	1					
Export (X3), billion USA	0.213	0.968	1				
Imports (X4), billion USA	0.191	0.973	0.994	1			
Capital investments (X5), billion USA	0.425	0.884	0.801	0.808	1		
Number of organizations performing research and development (X6)	0.295	-0.564	-0.561	-0.579	-0.230	1	
IIED	0.757	0.730	0.663	0.636	0.851	0.040	1

Fig. A3.2. **Correlation matrix for indicators of the integrated indicator economic development**

Source: compiled by authors on the basis on models of econometric analysis

Table A3.1

The results of building an economic and mathematical model

	b*	Std. Err. of b*	b	Std. Err. of b	p-value
Intercept			0.533027	0.153150	0.002121
X1	0.30233	0.16178	0.008086	0.003107	0.016262
X3	2.02942	0.902221	0.011480	0.005104	0.034830
X4	-2.97054	0.954425	-0.013738	0.004414	0.005076
X5	1.19889	0.189931	0.014910	0.002362	0.000002
X6	-0.72553	0.139654	-0.000490	0.000094	0.000033

Source: created by authors on the basis on models of econometric analysis