UDC 332.1+311.3
JEL Classification: R11; C43; C53; H56

Ivanova M. V., Harmider L. D., Zhitnia E. D.

STATISTICAL MARKERS OF EXTRAORDINARY EVENTS AND SOCIAL CRISES IN REGIONAL DEVELOPMENT IN UKRAINE

Ukrainian State University of Chemical Technology (Educational Scientific Institute "Ukrainian State University of Chemical technology"), Dnipro, Ukraine

The issue of socio-economic development of regions is an acutely relevant topic for Ukraine, therefore, understanding the precursors of crisis phenomena in the development of regions would definitely contribute to both the economic and political goals of the state. The purpose of the research was to find and determine statistical indicators-markers of socio-political crises and unexpected conflicts in the regions of Ukraine, with the indicators for the Donetsk region being singled out. The analysis of scientific literature revealed certain methodological problems regarding the fundamental possibility of forecasting extraordinary events and armed conflicts based on the data of past peacetime events. But with certain assumptions, we made an attempt to identify atypical and anomalous patterns of socio-economic indicators for the Donetsk region based on the characteristics of time series. during the conditionally stable period of 2010-2021. The conducted research showed that some statistical indicators of the socio-economic development of the regions of Ukraine really acquired extreme values or had different dynamics of time series. But there were also such statistical indicators, the meaning and dynamics of which were logically included in the general outline of the socio-economic development of the regions. Atypical and abnormal values in the Donetsk region. acquired the following indicators: migration outflow of the population; average per capita income and expenses, cyclical unemployment rate in the region. It is these characteristics of the socio-economic development of the regions that can be considered statistical markers of extraordinary events and socio-political crises. An attempt was made to present the time series of the "unemployment rate" indicator using the additive moving average model and exponentially smoothed according to the Holt-Winters model. Modeling the "unemployment rate" indicator, we did not see its predicted extreme change, but a significant gap with other regions of Ukraine remained. If we take into account the indicator and dynamics of incomes and expenses of the population of the Donetsk region, then the situation looks more critical and a certain dyad of regularities is observed: business cuts jobs, and the population consumes less and supports business. Another possibility is that economic operations in the Donetsk region were concealed, leading to a higher degree of economic shadowing compared to other regions. And this already indicates political distrust in the region towards the authorities and economic and legal norms.

Keywords: socio-economic development, regions, indicators-markers, socio-political crises, unexpected conflicts.

Introduction and statement of the problem

The socio-economic development of Ukraine's regions is a highly relevant topic, particularly considering the political context and national security concerns. Disproportions and contradictions in the socio-economic development of Ukraine's regions have become a breeding ground for unscrupulous political manipulations and artificial separation of society. Understanding the harbingers of crisis phenomena in the development of regions would definitely contribute to the economic and political goals of the state.

International conflict statistics use the following three categories: state armed conflict, non-state conflict, and unilateral violence. The large-scale war for the sovereignty of Ukraine, the complete destruction of the Eastern regions, actualize the question: was it possible in principle to foresee and predict such events, and what markers of statistical observations could testify to this. It is obvious that in the statistical information of Ukraine there can be no hint of the plans and aggressive actions of the aggressor country, therefore the causes of military conflicts as such are not discussed in this article. But every conflict, crisis, emergency or force majeure event has a devastating socio-economic continuation and consequences. Therefore, we focused this study on the harbingers or indicators-markers of such events.

Analysis and research of publications

Almost all currently known scientific methods of socio-economic forecasting [1] are adaptive in their essence and provide a vision of the future based on the fact of already realized events and scenarios of the past. Such a methodological approach is of great importance and good performance for forecasting routine events — processes, phenomena, scenarios with regularly recurring fluctuations or cycles. On the other hand, it is difficult to see the manifestation of unforeseen events or force majeure circumstances using this approach. Thus, with numerous detailed studies of the economy of the regions of Ukraine, for example, the socio-economic and political conflict that occurred in 2014—2015 was not prevented. These facts correspond to the well-founded conclusions of the authors [1], that armed conflicts have a long period between occurrences, so relative peace and socio-economic stability in several decades may not be statistically significant for predicting emergency or military events.

There are interesting studies on forecasting the risks of an armed conflict based on data on military spending on state defense [2]. But it is recognized that such costs are largely the result of current political decisions rather than objective circumstances. After all, "state defense expenditures" are well correlated with other economic indicators of the state — GDP, volume of industrial production, etc. Nevertheless, even with such restrictions, state defense spending is sufficiently indicative to determine changes in domestic political circumstances.

In the scientific literature, there are certain established ideas about the possibility of predicting military conflicts based on the analysis of temporal patterns on large data sets. Using formal quantitative approaches, it is difficult to detect regularities, which can be stretched, distorted or, as a rule, non-linear. It is emphasized [3] that the world of conflicts is actually non-linear, and this possibly long-term and non-linear dynamics cannot be identified by standard computational methods. A potentially useful approach to identifying patterns (or their absence) is, according to the authors [3], in (a) collecting more detailed time series related to conflict events, from financial data to news and diplomatic documents; and (b) application of the latest methodological developments in the field of machine learning of time series clustering to search for hidden patterns.

Forecasting theory is based on the premise that current and past knowledge can in principle be used to predict the future. In particular, with regard to time series, there is an opinion that it is possible to identify patterns in historical values and successfully implement them in the process of forecasting future values. Approaches based on the characteristics of time series can be implemented with the help of various statistical operations that allow detecting anomalous cases from the typical behavior of the research object. Estimates of time series processes can be significantly affected by the presence of several anomalous observations [1], such as: outliers, peaks, jumps, extreme observations. That is, abnormal statistical manifestations of certain indicators and/or the dynamics of such indicators can be signal markers of extraordinary circumstances and force majeure events.

Modern studies on the analysis of post-conflict situations and assessment of their consequences operate with a set of indicators of the socio-economic development of the country. Thus, in [4] a deeper understanding of the relationship between the conflict and the country's economy is provided based on the study of the experience of many countries. It is substantiated that the long-term socio-economic consequences of the conflict (for example, life expectancy and education, economic growth, well-being) depend on the degree of development of the country, that is, on the initial conditions of the beginning of an emergency event and the effectiveness of state regulation.

Ivanova M. V., Harmider L. D., Zhitnia E. D.

ISSN 2415-3974. Економічний вісник Державного вищого навчального закладу
"Український державний хіміко-технологічний університет", 2024, № 2, С. 41–47

43

We also find it useful to study the socio-economic situation in the country, but on a somewhat different interrelated issue and with a different purpose — as a statistical study of the relevant indicators for their atypical dynamics before the start of a full-scale war in Ukraine. Separate attempts at statistical generalization for the study of socio-economic crises were made by us earlier. It has been proven [5] that even against the background of a certain economic and socio-political stability, the risks of socio-economic contradictions in Ukraine were permanently aggravated. As an example and the reasons for such a situation, the strengthening of income differentiation in society was determined, which objectively and quite distinctly worsened over time. Regarding the study of the development of the regions of Ukraine, according to many scientific publications, in particular [6], the main factors of the crisis situation in the Donetsk region. economic factors were considered: the industrial decline and the inability of the «basic» branches of the region's economy to resist new forms of competition. Developing this opinion-hypothesis, we investigated the time series of a number of indicators of the socio-economic development of the Donetsk region. [7, 8], as well as their comparison with Dnipropetrovsk and average data for Ukraine. Dnipropetrovsk region was chosen as the most similar in terms of industry structure and specialization of the region's economy.

The purpose of the article

This research aimed to identify and analyze statistical markers indicating socio-political crises and unforeseen conflicts in Ukrainian regions, focusing on the Donetsk region.

Presentation main material

Using certain assumptions, we attempted to identify atypical and anomalous socio-economic patterns in the Donetsk region during the relatively stable period of 2010–2021. The conducted research showed that some statistical indicators of the socio-economic development of the regions of Ukraine really acquired extreme values or had different dynamics of time series. But there were also such statistical indicators, the meaning and dynamics of which were logically included in the general outline of the socio-economic development of the regions.

The following was clarified:

— the dynamics of most macroeconomic indicators — gross regional product; average monthly salary; the ratio of indices of the physical volume of the gross regional product and the index of average monthly wages; consumer price index by region — repeats the all-Ukrainian trend (or averaged indicators by region);

— migration movement of the population, presented in Fig. 1, revealed anomalous dynamics for the Donetsk region, but was such that it was somewhat stable for 2021;

— the dynamics of population expenditure indicators per UAH 1. income was also atypical for the Donetsk region: 25–30% lower than in Dnipropetrovsk and averaged data for other regions of Ukraine. The relevant data are presented in Fig. 2;
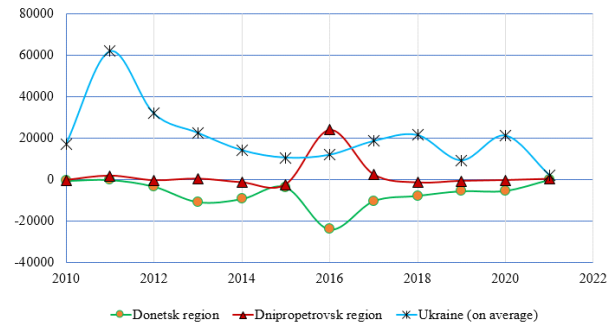

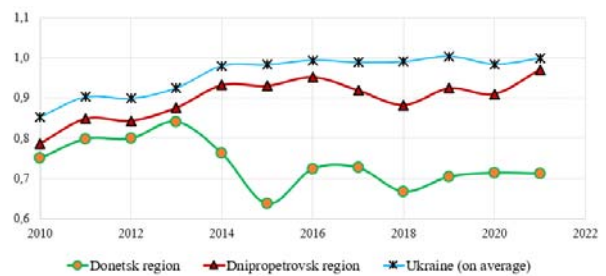Fig. 1. Population Migration Dynamics by Region in Ukraine, persons

Fig. 2. Dynamics of population expenditure indicators per 1 UAH income by regions of Ukraine

— the level of unemployment in the Donetsk region. demonstrated a significant and long-term excess of this indicator compared to other regions: 5–6% more than the average for Ukraine.

According to the given data, 2014–2015 turned out to be abnormal — the beginning of the military conflict in the Eastern regions. In the Table provides an analysis of statistical indicators by regions of Ukraine for 2016–2021, averaged in a certain way and brought to a single comparison base. The relevant indicators for Ukraine (on average) for 2015 were chosen as the basis for comparisons.

It can be seen (Table 1) that certain markers and imbalances in the development of the Donetsk region. are present even in the conditionally stable period of 2016–2021. So, in our opinion, abnormal values are acquired by the following indicators:

− migration outflow of the population from the Donetsk region, i.e. the departure of the population outside the region in a quantity that exceeded the average values for the regions of Ukraine by 2.27 times;

Normalized statistical indicators by regions of Ukraine

Statistical indicator	Values for:			Notes for the Donetsk region
	of Ukraine (on average)	Dnipropetrovsk Region	Donetsk region	
Migration population growth, %	37	7	−227	Anomalous value
Average monthly salary index	3.47	3.45	3.69	
Gross regional product growth, %	180	170	166	
Population income index	1.89	2.37	1.06	Atypically low value
Population expenditure index	1.92	2.21	0.76	Atypically low value
Unemployment rate, %, including cyclic	9.6 3.6	8.3 4.3	14.8 10.8	Anomalous value
Growth of social transfers, times	12	11	10	

− the population income index for the analyzed period almost did not change (increase by 1.06 times) in contrast to other regions of Ukraine, in particular the Dnipropetrovsk region − growth by 2.3 times;

− the population expenditure index also turned out to be atypically low − almost three times lower than in the Dnipropetrovsk region;

− the level of unemployment in the Donetsk region. shows the highest values of 14.8% among the studied objects. If the natural level of 4% is singled out in the general level of unemployment, then for the Donetsk region. indicators of the cyclical level of unemployment are abnormally high: 10.8% as opposed to 3.6% in the regions of Ukraine on average.

From those investigated in the Table 1 of the indicators that drew our greatest attention was the "unemployment rate". The level of unemployment, as an important socio-economic category, is traditionally considered from the point of view of labor market imbalance, socio-economic crises and risks of ensuring stability in society. Unemployment indicators can also in a certain way characterize moods, real expectations and hidden actions of business: curtailment of business activity, withdrawal of assets, efforts to preserve one's property. That is, an extremely high level of unemployment for the Donetsk region. is not a direct indication and expectation of external aggression or an armed attack, but a sign that there is a massive reduction of jobs in a certain region, and business entities are not interested in conducting economic activity in this area − it may well be. Such business behavior, in our opinion, can be determined either by intuitive assumptions or better awareness of business entities regarding political risks in the region and business prospects. All this fits into the business paradigm of «keep your property».

An attempt was made to present the time series of the «unemployment rate» indicator using the additive moving average model and exponentially smoothed according to the Holt-Winters model [9]. The smoothing constants б=0.95 and в=0.4 were determined by the method of iterations. The levels of the time series were divided into actual and trend components:

$$a_t = 0,95 \cdot y_t + (1 - 0,95) \cdot (a_{t-1} + b_{t-1}); \qquad (1)$$

$$b_t = 0,4 \cdot (a_t - a_{t-1}) + (1 - 0,4) \cdot b_{t-1}, \qquad (2)$$

where a_t − smoothed series data, b_t − the trend component of the series.

According to the calculations of the last components of the series, the forecast values of the unemployment rate for 2022−2024 were determined:

$$я_{T+k} = a_T + k \cdot b_T, \qquad (3)$$

where $я_{T+k}$ is the predicted level of the series; a_T − component of the level of the series for the last known time interval T; b_T − the trend component for the last known time interval T; k − the ordinal number of the forecasting period.

The results of the time series of the unemployment rate obtained according to models (1−3) are presented in Fig. 3 as actual data for 2010−2021 (solid lines) and modeled according to the forecast for 2021−2024 (dotted line).

Modeling the "unemployment rate" indicator (Fig. 3), we do not see its predicted extreme change, but the significant gap with other regions of Ukraine remains. If we take into account the indicator and dynamics of incomes and expenses of the population of the Donetsk region, the situation looks more critical. It can be seen (Fig. 2, Table 1) not only the reduction

Ivanova M. V., Harmider L. D., Zhitnia E. D.

ISSN 2415-3974. Економічний вісник Державного вищого навчального закладу
"Український державний хіміко-технологічний університет", 2024, № 2, С. 41-47

45

of jobs, but also a significant decrease in consumption at a fairly high wage. That is, a certain dyad of regularities is observed: business cuts jobs, and the population consumes less and supports business. Another possibility is that economic operations in the Donetsk region were concealed, leading to a higher degree of economic shadowing compared to other regions. And this already indicates political distrust in the region towards the authorities and economic and legal norms.
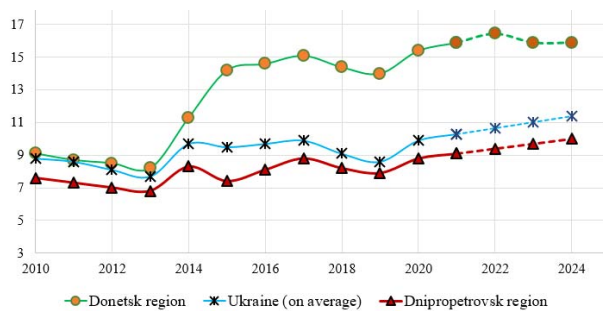

Fig. 3. Unemployment rate by region of Ukraine: actual and forecast values (Holt-Winters model, %)

Thus, in our opinion, a more objective forecast regarding extraordinary events in the region can be provided on the basis of those defined in the Table group of statistical indicators with an atypical-anomalous value − markers of socio-economic crises and using certain methods of machine learning to search for hidden regularities in time series. In this, we agree and support the conclusions of the authors [3] − forecasting experts.

Conclusions

The conducted research, which was based on the analysis of time series of statistical indicators of the socio-economic development of the regions of Ukraine, showed that there are some statistical indicators that acquired extreme values or had fundamentally different dynamics in the Donetsk region. even in the conditionally stable period of 2016−2021. These, in our opinion, abnormal values include: migration outflow of the population; average per capita income and expenses, cyclical unemployment rate in the region. It is these characteristics of the socio-economic development of the regions that can be considered statistical markers of extraordinary events and socio-political crises.

Beyond the identified statistical markers, the study highlights patterns suggesting businesses' awareness of political risks and/or distrust in regional authorities.

REFERENCES

1. Petropoulos, F., Apiletti, D., & Assimakopoulos, V. and others. (2022). Forecasting: theory and practice. *International Journal of Forecasting, 38,* 705−871. DOI: https://doi.org/10.1016/j.ijforecast.2021.11.001 [in English].

2. Solomytskyi, O., Semenenko, O., & Onofriychuk, P. etc. (2022). Metod prohnozuvannia ryzykiv vynyknennia zbroinoho konfliktu na osnovi rezultativ analizu obsiahiv voiennykh vytrat [The method of forecasting the risks of the occurrence of an armed conflict based on the results of the analysis of the volumes of military expenditures]. *Social Development and Security, 12(1),* 164-174. DOI: 10.33445/sds.2022.12.1.15 [in Ukrainian].

3. Chadefaux T. (2023). An automated pattern recognition system for conflict. *Journal of Computational Science*, *72,* 102074. DOI: https://doi.org/10.1016/j.jocs.2023.102074 [in English].

4. Le, T.-H., Bui, M.-T., & Uddin, G.S. (2022). Economic and social impacts of conflict: A cross-country analysis. *Economic Modeling,* 115, 105980. DOI: https://doi.org/10.1016/j.econmod.2022.105980 [in English].

5. Ivanova, M. V., & Ivanov, A. V. (2021). Socio-economic differentiation of society: statistical trends. *Ekonomichnyi visnyk Derzhavnoho vyshchoho Nnavchalnoho zakladu "Ukrainskyi derzhavnyi khimiko-tekholohichnyi universytet" − Economic Herald of the State Higher Educational Institution "Ukrainian State university of Chemical Technology", 2,* 15-20. DOI: 10.32434/2415-3974-2021-14-2-15-21 [in English].

6. Danylyshyn, B. M., & Snihova, O. Yu. (2019). *Formuvannia modeli ekonomichnoho rozvytku Donbasu v umovakh stanovlennia novoi rehiona-lnoi polityky [Formation of the economic development model of Donbas in the conditions of the formation of a new regional policy].* Kyiv: KPI named after Igor Sikorskyi, Polytechnic Publishing House [in Ukrainian].

7. Sait derzhavnoi sluzhbi statistiki Ukraini [Site of the State Statistics Service of Ukraine]. *ukrstat.gov.ua.* Retrieved from http://www.ukrstat.gov.ua. *Rehionalna statystyka − Regional statistics* [in Ukrainian].

8. Statystychnyi zbirnyk «Rehiony Ukrainy» 2021 (2022) [Statistical collection "Regions of Ukraine" 2021]. Part 1. Kyiv: State Statistics Service of Ukraine [in Ukrainian].

9. Sait Medium. *medium.com.* Lleyton A. A. (February 21, 2021). Thorough Introduction to Holt-Winters Forecasting. Retrieved from: https://medium.com/analytics-vidhya/a-thorough-introduction-to-holt-winters-forecasting-c21810b8c0e6 [in English].

СТАТИСТИЧНІ МАРКЕРИ НАДЗВИЧАЙНИХ ПОДІЙ І СОЦІАЛЬНИХ КРИЗ В РЕГІОНАЛЬНОМУ РОЗВИТКУ УКРАЇНИ

Іванова М. В., Гармідер Л. Д., Житня Є. Д.

Питання соціально-економічного розвитку регіонів є гостро-актуальною для України темою, тому розуміння передвісників кризових явищ в розвитку регіонів безумовно сприяло б і економічним, і політичним цілям держави. Метою дослідження був пошук та визначення статистичних показників-маркерів соціально-політичних криз і несподіваних конфліктів в регіонах України з виокремленням показників по Донецькій обл. Аналіз наукової літератури виявив певні методологічні проблеми щодо принципової можливості прогнозування надзвичайних подій і збройних конфліктів за даними минулих подій мирного часу. Але с певними припущеннями нами була здійснена спроба за характеристиками часових рядів виявити нетипові і аномальні закономірності соціально-економічних показників для Донецької обл. протягом умовно стабільного періоду 2010-2021 рр. Здійснене дослідження показало, що окремі статистичні показники соціально-економічного розвитку регіонів України дійсно набували екстремальних значень або мали відрізняльну динаміку часових рядів. Але також були такі статистичні показники, значення і динаміка яких логічно входили в загальну канву соціально-економічного розвитку регіонів. Нетипово-аномальних значень з Донецької області набували такі показники: міграційний відтік населення; середньодушовий дохід і витрати, циклічний рівень безробіття в регіоні. Саме ці характеристики соціально-економічного розвитку регіонів і можна вважати статистичними маркерами надзвичайних подій і соціально-політичних криз. Здійснено спробу надати часові ряди показника «рівень безробіття» за адитивною моделлю ковзного середнього та експоненціальним згладженим за моделлю Холта-Вінтерса. Моделюючи показник «рівня безробіття», ми не побачили його прогнозованої екстремальної зміни, але суттєвий розрив з іншими регіонами України зберігався. Якщо прийняти до уваги показник та динаміку доходів і витрат населення Донецької області, то ситуація виглядає більш критично і спостерігається певна діада закономірностей: бізнес скорочує робочі місця, а населення менше споживає і підтримує бізнес. Можливе і інше припущення: в Донецькій області мало місце приховування результатів господарських операцій і тінізація економіки в більшому, ніж в інших регіонах, ступені. І це вже свідчить про політичну недовіру в регіоні до влади і господарсько-правових норм.

Ключові слова: соціально-економічний розвиток, регіони, індикатори-маркери, соціально-політичні кризи, непередбачувані конфлікти.

STATISTICAL MARKERS OF EXTRAORDINARY EVENTS AND SOCIAL CRISES IN REGIONAL DEVELOPMENT IN UKRAINE

Ivanova M. V., Harmider L. D., Zhitnia E. D.*
Ukrainian State University of Chemical Technology (Educational Scientific Institute "Ukrainian State University of Chemical technology"), Dnipro, Ukraine

*e-mail: 470629.marina@gmail.com
Ivanova M. V. ORCID: https://orcid.org/0000-0003-2620-7168

Harmider L. D. ORCID: http://orcid.org/0000-0001-7837-2734

The issue of socio-economic development of regions is an acutely relevant topic for Ukraine, therefore, understanding the precursors of crisis phenomena in the development of regions would definitely contribute to both the economic and political goals of the state. The purpose of the research was to find and determine statistical indicators-markers of socio-political crises and unexpected conflicts in the regions of Ukraine, with the indicators for the Donetsk region being singled out. The analysis of scientific literature revealed certain methodological problems regarding the fundamental possibility of forecasting extraordinary events and armed conflicts based on the data of past peacetime events. But with certain assumptions, we made an attempt to identify atypical and anomalous patterns of socio-economic indicators for the Donetsk region based on the characteristics of time series. during the conditionally stable period of 2010-2021. The conducted research showed that some statistical indicators of the socio-economic development of the regions of Ukraine really acquired extreme values or had different dynamics of time series. But there were also such statistical indicators, the meaning and dynamics of which were logically included in the general outline of the socio-economic development of the regions. Atypical and abnormal values in the Donetsk region. acquired the following indicators: migration outflow of the population; average per capita income and expenses, cyclical unemployment rate in the region. It is these characteristics of the socio-economic development of the regions that can be considered statistical markers of extraordinary events and socio-political crises. An attempt was made to present the time series of the "unemployment rate" indicator using the additive moving average model and exponentially smoothed according to the Holt-Winters model. Modeling the "unemployment rate" indicator, we did not see its predicted extreme change, but a significant gap with other regions of Ukraine remained. If we take into account the indicator and dynamics of incomes and expenses of the population of the Donetsk region, then the situation looks more critical and a certain dyad of regularities is observed: business cuts jobs, and the population consumes less and supports business. Another possibility is that economic operations in the Donetsk region were concealed, leading to a higher degree of economic shadowing compared to other regions. And this already indicates political distrust in the region towards the authorities and economic and legal norms.

Keywords: socio-economic development, regions, indicators-markers, socio-political crises, unexpected conflicts.

ISSN 2415-3974. Економічний вісник Державного вищого навчального закладу
"Український державний хіміко-технологічний університет", 2024, № 2, С. 41-47

47

REFERENCES

1. Petropoulos, F., Apiletti, D., & Assimakopoulos, V. and others. (2022). Forecasting: theory and practice. *International Journal of Forecasting, 38,* 705−871. DOI: https://doi.org/10.1016/j.ijforecast.2021.11.001 [in English].

2. Solomytskyi, O., Semenenko, O., & Onofriychuk, P. etc. (2022). Metod prohnozuvannia ryzykiv vynyknennia zbroinoho konfliktu na osnovi rezultativ analizu obsiahiv voiennykh vytrat [The method of forecasting the risks of the occurrence of an armed conflict based on the results of the analysis of the volumes of military expenditures]. *Social Development and Security*, *12(1),* 164-174. DOI: 10.33445/sds.2022.12.1.15 [in Ukrainian].

3. Chadefaux T. (2023). An automated pattern recognition system for conflict. *Journal of Computational Science*, *72,* 102074. DOI: https://doi.org/10.1016/j.jocs.2023.102074 [in English].

4. Le, T.-H., Bui, M.-T., & Uddin, G.S. (2022). Economic and social impacts of conflict: A cross-country analysis. *Economic Modeling,* 115, 105980. DOI: https://doi.org/10.1016/j.econmod.2022.105980 [in English].

5. Ivanova, M. V., & Ivanov, A. V. (2021). Socio-economic differentiation of society: statistical trends. *Ekonomichnyi visnyk Derzhavnoho vyshchoho Nnavchalnoho zakladu "Ukrainskyi derzhavnyi khimiko-tekholohichnyi universytet" − Economic Herald of the State Higher Educational Institution "Ukrainian State university of Chemical Technology", 2,* 15-20. DOI: 10.32434/2415-3974-2021-14-2-15-21 [in English].

6. Danylyshyn, B. M., & Snihova, O. Yu. (2019). *Formuvannia modeli ekonomichnoho rozvytku Donbasu v umovakh stanovlennia novoi rehiona-lnoi polityky [Formation of the economic development model of Donbas in the conditions of the formation of a new regional policy].* Kyiv: KPI named after Igor Sikorskyi, Polytechnic Publishing House [in Ukrainian].

7. Sait derzhavnoi sluzhbi statistiki Ukraini [Site of the State Statistics Service of Ukraine]. *ukrstat.gov.ua.* Retrieved from http://www.ukrstat.gov.ua. *Rehionalna statystyka − Regional statistics* [in Ukrainian].

8. Statystychnyi zbirnyk «Rehiony Ukrainy» 2021 (2022) [Statistical collection "Regions of Ukraine" 2021]. Part 1. Kyiv: State Statistics Service of Ukraine [in Ukrainian].

9. Sait Medium. *medium.com.* Lleyton A. A. (February 21, 2021). Thorough Introduction to Holt-Winters Forecasting. Retrieved from: https://medium.com/analytics-vidhya/a-thorough-introduction-to-holt-winters-forecasting-c21810b8c0e6 [in English].