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This book includes abstracts of the 7th International Conference "Information Technology and Interactions (Satellite) – 2020". Philosophical, theoretical and applied aspects which describe the results, problems and prospects of the creation and use of intelligent computing methods and creating of information systems and technology on their basis are reviewing.

Main tracks of the conference are: Artificial Intelligence Technologies, Cyberspace Protection Technologies, Data Analytics, Digital Project Management Technologies, E-commerce, E-government and E-learning Technologies, Mathematical Foundations of Information Technology, Network and Internet Technologies.

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NEURAL NETWORK ANALYTICS AND FORECASTING THE COUNTRY'S BUSINESS CLIMATE IN CONDITIONS OF THE CORONAVIRUS DISEASE (COVID-19)

Abstract. The paper proposes an approach to modeling the business climate of the country, which is based on the principles of information transparency, and makes it possible to assess the development trends of the studied indicator in conditions of the COVID-19. This approach has been tested on the example of Ukraine. The results obtained make it possible to analyze the cyclical development of the country's economy with high accuracy and reliability even under quarantine restrictions.

Keywords: Business climate, Business confidence index, Correlation analysis, Socio-economic indicators, Taxonomic model, Neural network model, COVID-19.

The dynamism of changes in the business climate of the countries of the world is accompanied by the increasing uncertainty of the external environment and internal disturbances of socio-economic systems. This is a reaction to new conditions of functioning and development, the emergence of which is due to the global pandemic and quarantine restrictions. The sensitivity of the business climate to such changes is high, therefore, the trends in the indicators that characterize it require system monitoring, thorough and multidimensional data analysis, and increased forecasting accuracy without time delay. This ensures that proactive management decisions are made on time in the context of the impact of COVID-19, which determines the goal and the task of this research.

One of the key indicators that determine the country's business climate is the business confidence index (BCI). The assessment of the business climate is based on the results of generalizing the opinions of business entities about their expectations of the dynamics of changes in production, demand, reserves, the general socio-economic state in the country. Therefore, the results of surveys of business entities, which underlie the formation of the BCI, determine the subjectivity, vagueness, and poor structuredness of the constructed index, which well-known researchers are trying to overcome. Despite the obvious subjectivity of the methodic approach to assessing the business climate of countries, scientists have repeatedly proved the close relationship of

the series of its values with the dynamics of macroeconomic indicators.

To solve the problem of predicting trends in the business climate of countries as a tool for strategic analysis, a wide range of forecasting tools is actively used. The paper proposes an approach to modeling the business climate of the country, which is based on the principles of information transparency, and makes it possible to assess the development trends of the studied indicator in conditions of the COVID-19.

The authors' previous research was based on statistical methods, however, the popularity and efficiency of neural network technologies proved the expediency of their application to solving problems of forecasting the country's business climate. The authors proposed to predict the business confidence index (BCI) using a methodological approach, which includes the step-by-step construction of taxonomic and neural network models.

As a result of using the methodological approach, a time series of quarterly values of the business confidence index in Ukraine was predicted for the period 2008-2020. The forecast was based on socio-economic indicators selected by their closeness to the business confidence index, namely: Retail sales, Industrial production, Steel production, Export, Imports and GDP annual growth rate. The forecast value of the composite index of business activity is obtained as follows:

$$\begin{aligned}\overline{BCI_i} &= W_1 \cdot RS_i + W_2 \cdot IP_i + W_3 \cdot SP_i + W_4 \times \\ &\times Exports_i + W_5 \cdot \mathrm{Im}\ ports_i + W_6 \times \\ &\times GDP\_AGR_i = 0,218 \cdot RS_i + 0,176 \times \\ &\times IP_i + 0,128 \cdot SP_i + 0,096 \cdot Exports_i + \\ &+ 0,096 \cdot \mathrm{Im}\ ports_i + 0,286 \cdot GDP\_AGR_i\end{aligned} \quad (1)$$

The quarterly values of socio-economic indicators for the past thirteen years (2008-2020) were taken as input data. The results of taxonomic analysis established that the GDP annual growth rate and retail sales have the greatest impact on the business confidence index. A forecast has been built for the trend of changes in the business confidence index (forecast accuracy of 89.38%), which proves the similarity of development trends in the country's business climate.

In addition, the most important thing is that the tendency of the studied indicators is identical, in particular, during the period of the emergence of crisis phenomena (beginning of 2009, end of 2014, beginning of 2015, period of the COVID-19 in second quarter of 2020), the decrease in the level of indicators is similar, which suggests that there is a real possibility of using the alternative to business confidence index, which calculated by the taxonomic method of in order to predict the business climate in conditions of limited information transparency.

Having determined the predicted value of the business confidence index (BCI) using a taxonomic model in accordance with the proposed methodology, the next step is forecasting using neural network technologies. An artificial neural network consists of one hidden layer, which contains two neurons, and one output layer (business confidence index). The number of variables in the input layer corresponds to the

number of selected economic indicators for modelling, i.e. six. Thus, to predict business confidence index, used the neural network of the type [6–2–1].

The activation function of the hidden layer is the sigmoid function. This type of function is often used for modeling and the outgoing values of such a function continuously fill the range from 0 to 1. The learning algorithm is the back-propagation error algorithm (Back-Propagation) with a learning rate of 0.1. The difference between the reference and the real output of the network is less than 0.05 (learning rate). The number of learning iterations is 10000.

Formation and analyzing a neural network model were carried out on the basis of the analytical platform Deductor Studio Academic 5.3, which allows you to perform all the steps of data mining from their loading and visualization to building and evaluating the quality of finished models. The time period for analysis is 50 values (first quarter of 2008 - second quarter of 2020). The training set consists of 88% of the data (44 values, time period between first quarter of 2008 and fourth quarter of 2018), and the test set – 12% of data (6 values, time period between first quarter of 2019 and second quarter of 2020).

The constructed neural network model with training capabilities showed the best results in the accuracy and quality of the forecast (forecast accuracy of 96.22%). A decrease in the business confidence index is predicted in third quarter 2020 (will be 87.65). The sharp decrease in the dynamics of the indicator in the studied forecast period is also explained by the influence of the negative consequences of COVID-19 and the introduction of quarantine restrictions in the country and the world.

The article examines the risks of deteriorating the business climate in Ukraine, as a result of which such preconditions as: the weakness of the judicial system, corruption, political and economic instability, the growth of tax pressure, changes in legislation, the slowdown and curtailment of reforms are identified. The situation due to the introduction of prolonged restrictive measures due to COVID-19 was worsened. Insufficient attention has been established in Ukraine to the issues of the ecological system's influence on the formation of the country's business climate, which requires a separate research.

The results obtained make it possible to analyze the cyclical development of the country's economy with high accuracy and reliability even under quarantine restrictions.

The effectiveness of the proposed alternative approach is manifested in saving costs for generating input data for assessing the country's business climate by using official statistics instead of survey results, the subjectivity of which is much higher. In general, the implemented alternative approach is unified, can serve as the basis for further deepening the methodological provisions for studying the business climate of countries with high accuracy and reliability of the results. The prospect of the research is to determine the impact of COVID-19 and introduction of quarantine restrictions on the value and dynamics of the business climate in other countries.

The problem for the implementation of an alternative approach remains limited access to key statistics, which is the result of a policy of ensuring information transparency in different countries.

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