

Digital Use in Assessment of Economic and Social Systems Economic Security

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Abstract—The paper considers the issues and problems of the digitation in the field of analysis and evaluation of the economic security of the region in modern conditions of the Russian economy. The basic concepts and categories of economic security of the region are defined. Methodological approaches to the formation of integral characteristics of regional economic security have been studied. Forecasting methods are considered taking into account the need to assess future characteristics of the level of economic security. The indicators of ensuring accuracy of the developed forecasts are considered.

Keywords—*economic security; region; digital (technologies); forecasting; judgmental methods; indicator*

I. INTRODUCTION

Active digitation is one of the most important priorities for achieving a high level of economic security in the Russian Federation.

According to data provided by the World Bank, the share of the digital economy in the total volume of global GDP reaches 5.5%, and experts predict its significant growth, by 2035 its volumes will have exceeded 16 trillion dollars. Russian Federation currently ranks 39th in the world countries ranking, the share of the digital economy in the gross domestic product of Russia is 3.9%, with most of this part of GDP (84%) being formed in the sphere of consumption.

The relevance of the use of digital technologies across all sectors of social and economic activity is driven by the amenities that characterize these technologies, as well as the high level of accuracy of the calculations carried out with making use of them. Thus, digital technologies are of real importance for sharp estimate of the level of economic security and modelling various scenarios for its provision.

Extensive use of digital technologies in various sectors of the Russian economy allows not only to increase the level of economic security of the region, but also to create full range of preventive measures aimed at counteracting the negative impact of various macroeconomic threats.

II. PREREQUISITES AND REGULATORY SUPPORT FOR DEVELOPMENT OF DIGITAL TECHNOLOGIES IN THE FIELD OF ECONOMIC SAFETY OF THE REGION

Reforming the national economic system based on the principles of the digital economy presupposes the creation of a set of systemic measures and tools that are used to advance efficiency of the process of the national economy digital transformation. Creation and effective functioning of the digital economy in the framework of the modern organizational and production structure of the Russian economy and the established management system seems to be impossible.

The definition of the digital economy, as given in The Strategy for the Development of the Information Society, suggests that information component is fundamentally changing the nature of the financial and business performance carried out by economic agents. It should be taken into account that conducting analytical processing of a significant amount of information data and using the results of expert analytics in the digital economy gives greater priority to security concerns. In general, it can be said that a systematic approach should be taken to improve the economic policy of the state. This implies the need for coordinated methods, mechanisms and actions, both for the development of industrial policy and for the development of the economic strength of the country, which suggests further structural transforming the entire national economic system. This goal is defined by the Economic Security Strategy until 2030 adopted in May 2017 [1].

In the above-mentioned Economic Security Strategy of the Russian Federation, the existing lag in the digital economy technologies is deemed to be a threat to economic security. The development of digital economy technologies is identified as one of the objectives of public policy in the area of economic security. Digitalization enhances the competitiveness of industrial complexes, the national economy as a whole, and accommodates economic growth.

The strategy identifies a number of threats to economic security that may result from the development of digital technologies:

- The developed countries' ambitions to use their economic and high-tech development advantages as a global competitive tool, which project influence on the state of technological sovereignty of the Russian Federation. To minimize this threat, it is necessary to create in Russia its own electronic components base and basic programming support
- The use of discriminatory measures against key sectors of the Russian national economic system, application of restrictions on access to foreign financial resources and modern technologies. This is the result of the sanctions imposed, including the ones in the field of high-tech products. Minimizing this risk requires the transfer of critical information systems to domestic services
- The exposure of the financial system of the Russian Federation to global risks (including the use of speculative foreign capital), as well as the high level of vulnerability that characterizes the information infrastructure of the financial and banking systems, as exemplified by successful cyber attacks against domestic banks through the use of the Internet. In this area, the Russian Federation has achieved significant success by creation of the state center "Financial Sector Computer Emergency Response Team" - FinCERT, however, the utility of this organization has not yet been appreciated by all banks
- Depletion of development opportunities based on the raw-materials export model, which drastically reduces the role of traditional factors of economic growth, resulting from scientific and technological changes. This directly points to an unacceptably high level of dependence of the domestic economy on oil prices on the world market. Rise in high-tech products exports is the proven way to break this dependence
- Low innovation level, lagging behind in the creation and implementation of new and promising technological developments (including digital economy technologies), inadequate expertise and lack of core competence of Russian specialists. This threat is one of the main ones in terms of ensuring the progressive advance of the Russian IT industry, which is due to the small amount of investment in long-term and complex projects that involve development of domestic IT products

- Growing global competition in the field of attracting high-end professionals. This problem in the Russian Federation has been dubbed a "brain drain", which has led to a shortage of highly qualified personnel, primarily in the IT sector.

The structure, procedure for the formation and functioning of the risk management system, as well as the regulations for its cooperation with the system of distributed Situational Centers, coordinating with Federal agencies of executive authority and bodies of state power of the subjects of the Russian Federation, are determined by the Government of the Russian Federation.

Executive Order No. 208 "On the Russian Federation Economic Security Strategy until 2030" also establishes mechanisms for ensuring economic security. Information technology area involves:

- Ensuring sustainable robust real economy growth;
- Creating and sustained development of advanced high-tech sectors of the economy;
- Support for high-tech small and medium-sized businesses, related to the development of innovation sector of the national economy, in the framework of which information technologies are created;
- Creating economic environment for development and implementation of up-to-date technologies, driving innovations, and strengthening the legal and regulatory framework in this area;
- The need to break the critical dependence on imports of research estate, experimental, test and production equipment, devices and microelectronic components, computer software and hardware, breeding and genetic materials;
- Integration of education, science and production operation to improve competitiveness of the Russian economy;
- Providing access to foreign technology solutions for the national economy interests;
- Development of technologies (including digital economy technologies) designed to strengthen the competitive position of the Russian Federation in the world commodity markets with a high level of added value, including photonics, biotechnologies, additive technologies and new materials;
- Regulating the cross-border transfer of domestic technologies and R&D deliverables, in compliance with the national interests of the Russian Federation;
- Encouraging the use of IP assets in business operations;
- Improving the regulatory framework and fostering the development of new high-tech products markets as the result of the implementation of the National Technology Initiative projects. This item has a direct bearing on IT, as it involves solving problems related

to the development of domestic component base, foreign technologies transfer, integration of science, IT developers and industry, development of educational technologies in IT sphere, export-controlled technologies, and many other aspects;

- Promoting the sustainable development of the national finance system;
- Improving specialized tools designed to support financing strategic industries, knowledge-based and high-tech industries;
- Improving the infrastructure component of the domestic financial market, the national payment system, the national payment card system and the financial messaging system;
- Counteraction to shadow schemes of the non-cash funds application, cash utilization and laundering of proceeds of criminal activity. The size and complexity of the information system created in the framework of the financial system of the Russian Federation make the task of separating its development from the development of IT extremely difficult. Nevertheless, it may be said that the use of payment systems and protection tools against fraud is unequivocally based on information systems, where domestic inland products must also be designed and foreign ones driven out.
- Promoting the efficiency level of activities related to foreign economic cooperation and realization of competitive advantages of the Russian economy export-oriented sectors;
- Support for Russian organizations in the field of transfer and insertion of advanced technologies;
- Encouraging the development of domestic business entities operating in the non-commodity sector of the national economy, ensuring their reaching the level of the world economy global leaders. These measures are aimed at facilitating the transfer of the most promising imported technological developments and exports of the most commercially successful high-tech Russian developments in the global commodity markets.

In general, it can be stated that this Executive Order focuses on the active development of IT industry and digital technologies themselves in order to achieve a high level of economic security and ensure the sustainability of the national economy of Russia.

III. MODERN PRACTICE FOR EVALUATING THE LEVEL OF ECONOMIC SECURITY OF THE REGION

Economic security of the region refers to the ability of the territory to ensure sustainability and progressive advance in terms of economic self-sufficiency and integration with the national economic system of the Russian Federation with credible negative impact of adverse factors (security threats),

as well as the ability to bolster resistance to various threats, lessen and neutralize their effects.

The challenges of evaluating and monitoring the achieved level of regional economic security are not related to the lack of sufficient approaches and concepts, but rather to the existence of a large number of developed models within separate aspects of modern economy performance. [2]

In the most general terms, economic security can be monitored upon a comprehensive assessment or upon priority selection of one of the economic security components and its in-depth study.

Benchmarks and indicators of economic security are a set of parameters that provide a general description of the state of the economic system. This set of indicators is not uniform for all regions and, in addition to the significant parameters chosen, is intended to assess the characteristic properties of regional economic systems and the potentially hazardous areas.

Despite the fact that the security indicators system is a crucial element in ensuring and improving the economic strength of regional reproduction complexes, the Russian Federation has not yet established a common adopted, statutory methodology (practice) for calculating indicators and their thresholds to analyze the level of economic security of the regional economy.

Assessment and determination of the level of economic security of the region is based upon the analysis of key indicators, calculation of regional pace of growth rates, forecasting their changes and dynamics; expert estimation is carried out in order to give quantitative characteristics and qualitative description of the processes analyzed; scenarios evaluation and analytics, optimization methods, pattern recognition techniques, game-theoretic methods of multivariate statistical analysis etc. are practiced.

Assessing the economic security of the region involves the use of various methods, each characterized by a number of strengths and shortcomings. Here we can distinguish the following methods: methods based on the calculation and monitoring of key macroeconomic indicators, as well as their benchmarking; Methods based on the indicative analysis; Delphi approach that results in ranking regions by threat level; methods assuming the use of relative rate indices based on key macroeconomic indicators and their comparative movements; methods of technical analysis, including multivariate statistical analysis, game theory with nature, etc.; methods using economic tools to assess the negative consequences of security threats through asset losses quantitative assay [3].

Existing methodologies for assessing the economic security of a region include three main groups of indicators that involve: a single index (most often, these are relative values that are determined per capita); decomposition by singling out aggregated groups of primary indicators; assessment of damage (calculating an integral compromise (trade-off) estimation of the socio-economic security of the region).

Apart from these, it is necessary to analyze the indicators that characterize not only the region under study, but also the average all-Russian values of universal indicators and, if possible, the average values by federal district, which the region under investigation belongs to.

Modern methodological approaches to the integrated assessment of regional economic security suggest the following: clarification of the ongoing research objectives; selection of estimated figures that make it possible to give account of economic security by the main substantive modules (most often, these are characteristics of economic, social and innovative development); setting thresholds for each particular indicator of the economic security of the region; calculation of the integrated index of economic security; determining the degree of particular indicators contribution to the formation of the summarizing indicator of the economic security of the region; semantic interpretation of the integral indicator of the economic security of the region calculated following the results of the study ("Fig. 1").

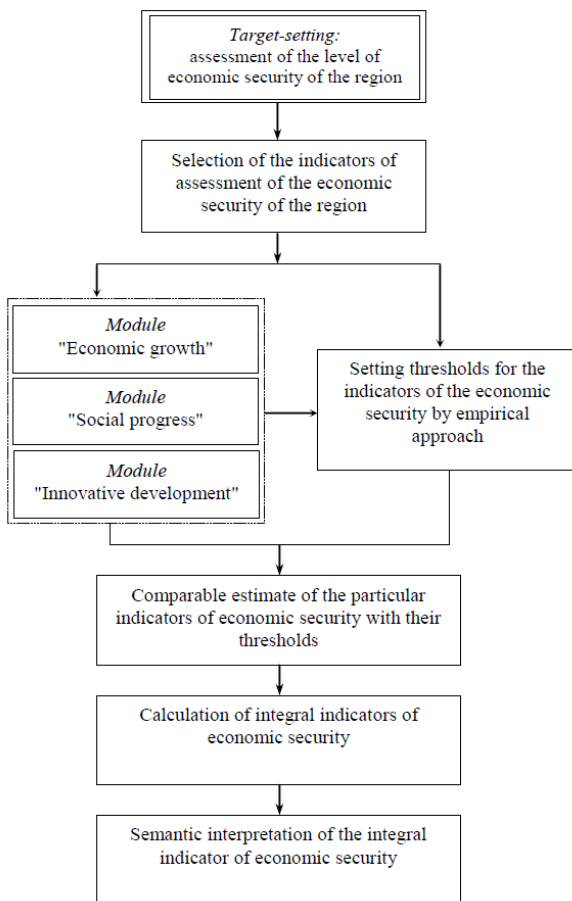


Fig. 1. Methodological approaches to the calculation of the integral indicator of economic security of social and economic systems.

Considering the variety of factors affecting the level of economic security and its multilevel system, a significant number of different indicators have been developed to characterize the level of security, as well as approaches to their determination. The absence of the system that gives the

opportunity to classify the existing indicators through the economic security (as a separate category) perspective makes it difficult to solve this problem.

The level of economic security of a particular region is characterized by the following set of fundamental indicators [4]:

- Functioning resilience and sustainability of the development of the region;
- Stability of functioning and development of the regional capital and insurance market;
- Level of economic security and sustainability of business entities operating in the region;
- Level of economic security of the population.

Incisive analysis (overview) of the existing methodologies of Russian and foreign scientists in this field makes it possible to develop an integrated approach to the selection of quantitative characteristics of the economic security of the region, requiring analysis of the following strands of research, covering the most important areas of the regional economy and taking into account the specific features of its current state and development.

In the framework of this approach, the following modules are to be distinguished:

- Economic advancement:
 - GRP per capita, billion rubles;
 - Annual inflation rate, %;
 - Fixed asset formation, % of GRP;
 - Foreign trade surplus, % of GRP;
 - Consolidated budget balance of the region,% of GRP.
- Social progress:
 - Average income - cost of living ratio, times;
 - Average pension - average wages ratio, %;
 - Unemployment rate according to the ILO methodology, %;
 - Life expectancy at birth, years;
 - Average housing space per person, m²;
 - Funds for health care, education and welfare (social policy), % to GRP.
- Innovative development:
 - Share of shipped innovative products as a percentage of all shipped industrial products, %;
 - Number of people engaged in R&D per 10 thousand of the employed population;
 - Research and development internal expenditures, % to GRP.

The threshold values of economic security indicators should be calculated empirically based on the assessment of indicators trend data representative of the social and economic development of the region, as well as taking into account the fundamental provisions of the Economic Security Strategy of the Russian Federation for the period until 2030 [5].

The use of this system of indicators and their thresholds will give the opportunity to assess the economic security of the region and to identify high-risk areas in various fields of regional economic system, beyond which the risk of balance disturbance and progressive development of the elements of regional economy, to be affected by crisis events may exist.

IV. FUNDAMENTALS OF FORECASTING THE LEVEL OF REGIONAL ECONOMIC SECURITY

When forecasting the level of economic security formalized methods is predominantly used, which are based on mathematical theories that enhances the reliability and accuracy of forecasts that significantly reduces timelines to ensure information processing and outcome evaluation.

The extrapolation method consists in applying the tendency for the development of the economic process that is specific to the base period to the forecast period, i.e., it is based on the assumption that he previously existing conditions for the development of the process will be maintained in future. The application of this method requires information on the degree of sustainability of the development trends of the process (phenomenon, object) over a period 2-3 times the forecast period. The sequence of actions in the process of extrapolation involves the following [6]:

- Clear definition of the problem, generation of the hypothesis on the possible directions of the forecasted process development, the analysis of factors contributing to or hampering the development of this process, determining the necessary extrapolation and its validation period;
- Selection of a set of parameters, unification of different units of measurement, which relate to each parameter separately;
- Acquisition and collation of quantitative data, assessment of their homogeneity and comparability;
- Determination of trends or symptoms of alteration in the parameters under study in the process of the statistical analysis and direct extrapolation of data.

The extrapolation operation in its most general form can be represented as determining the value of a function:

$$Y_{i+L} = F(Y_i \times L) \tag{1}$$

where Y_{i+L} stands for extrapolated level value;

L is a pre-emption period;

Y_i stands for the level taken as an extrapolation base.

The use of extrapolation method is characterized by reliable results in predicting certain processes (phenomena, objects) for a period of 5 to 7 years.

The forecast accuracy will be higher, provided the minimum error value determined by the difference between the predicted and the actual value of the variable under study.

The main problem is to calculate the forecast error, since the actual value of the predicted indicator will not be known until the future. Therefore, the methods for assessing accuracy of already fait accompli (a posteriori) have no use value, since they are only a statement of fact. Forecast development requires pre-evaluating its accuracy (a priori) when the true value of the indicator predicted remains to be seen. [7]

To estimate the forecast accuracy, the calculation of the root mean square error (RMSE) of prediction is made according to the formula:

$$\bar{S}_{RMSE} = \sqrt{\frac{\sum (y_t^{obs} - y_t^{mod})^2}{n}} \tag{2}$$

The correlation coefficient between the forecast (model output) and observed values of the variable is used as a comparative indicator of forecast accuracy, which is calculated using the following formula:

$$r_{y^{act}, y^{pr}} = \frac{\sum (y_t^{pr} - \bar{y}_t^{pr}) \cdot (y_t^{act} - \bar{y}_t^{act})}{\sqrt{\sum (y_t^{pr} - \bar{y}_t^{pr})^2 \cdot \sum (y_t^{act} - \bar{y}_t^{act})^2}} \tag{3}$$

When using this coefficient to assess the accuracy of forecasting the level of economic security, it is necessary to take into account that the pair correlation coefficient, by its nature, describes a linear relationship between two variables and reflects only the relationship between the time series of observed (true) values and the series of forecast (modelled) values of the indicators under investigation. In addition, even if the correlation coefficient reaches a value of 1, this does not mean a complete coincidence of actual (observed) values and forecast estimates, but indicates only the presence of a linear relationship between the time series of modelled and observed values of the indicator.

One of the indicators of the accuracy of statistical forecasts is the Theil Inequality Coefficient (IC), which was proposed by G. Theil and can be calculated using the formula:

$$IC = \sqrt{\frac{\sum (y_t^{act} - y_t^{pred})^2}{\sum (y_t^{act} - \bar{y}_t^{act})^2}} \tag{4}$$

$IC = 0$ indicates that the model predictions are as accurate as the mean of the observed data (actual values).

Furthermore, the forecast accuracy can be estimated by the value of the confidence band for a specified probability of its implementation, and accuracy means a quantitative

estimator of the probability of forecast implementation within the specified confidence band. Thus, the accuracy of the forecast can be expressed through the probability limits of the actual magnitude of the predicted value.

Therefore, possessing economics and statistics tools for predicting potential threats, regional authorities taking control of the social and economic systems have the opportunity to develop a comprehensive set of preventive measures that will ensure the business continuity of regional reproductive systems.

V. CONCLUSION

The use of digital technologies in the modern context is one of the most promising technique of improving management system both at the federal and regional levels, ensuring the following results: enhancing manageability of regional reproduction systems and the national economic system, creation of uniform, valid methods of assessing the level of economic security of regional economic systems. Overall, this makes it possible to form a common base of business insights used for making justified managerial solutions, obtaining objective information on regional authorities' performance results, which provides more effective controlling.

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