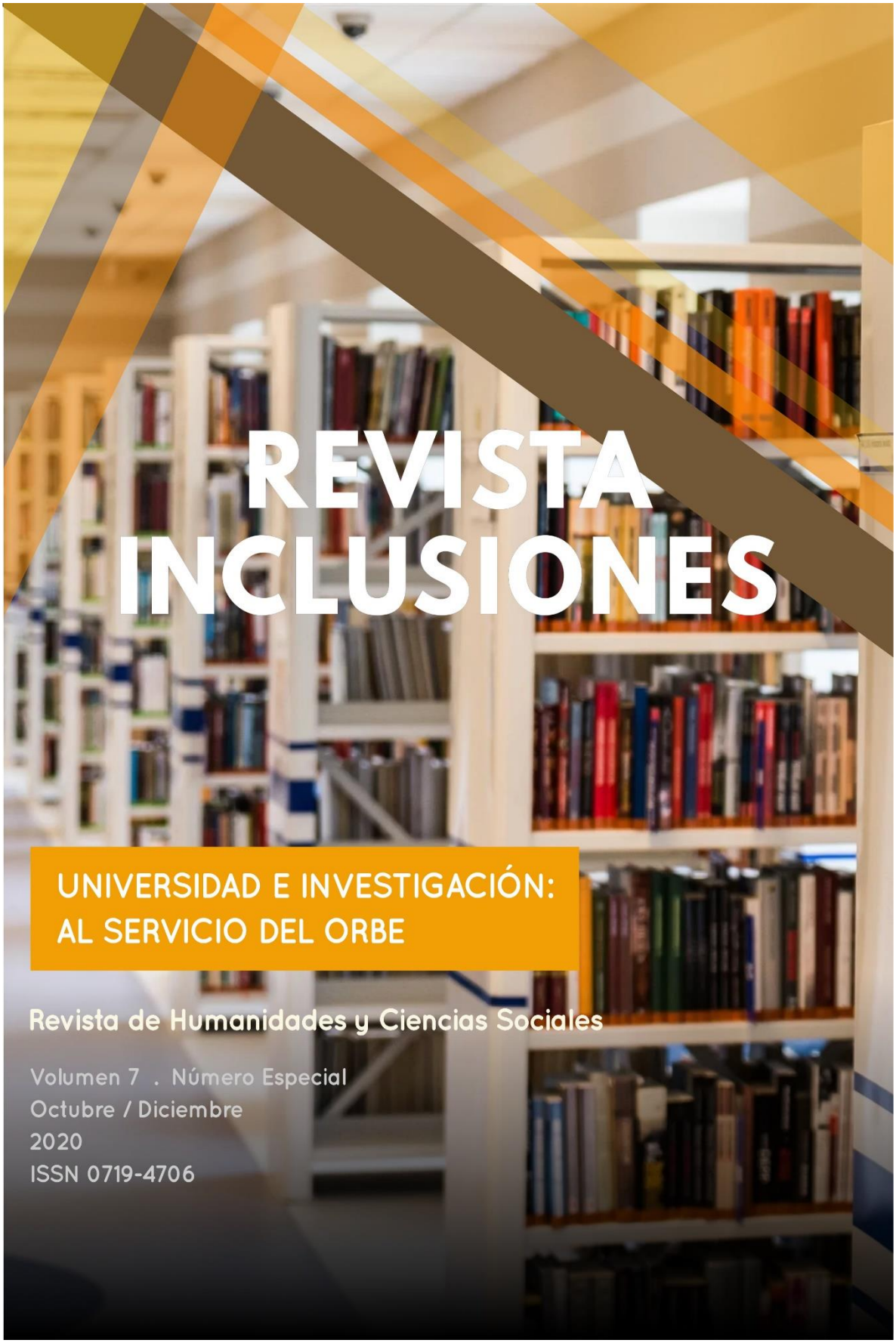

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PRINCIPLES AND MECHANISMS FOR ASSESSING AND FORECASTING CRISES IN THE CONTEXT OF DIGITALIZATION

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Abstract

The authors study the existing principles and mechanisms for assessing and forecasting crises, as well as determine the possibility of using them in the context of digital transformation. The following research methods are used in the work: empirical, theoretical and quantitative. Within the framework of the study, the authors explore the literary sources on the issue, in particular, works that examine assessment and forecasting principles and works on crisis management and the influence of Industry 4.0 on the current changes in the world. The authors study the general management mechanism and justify the possibility for using the mechanism at organizational, regional, national and global levels. The most common approaches to crisis forecasting are explored. The authors provide the calculation wherein the crisis forecasting mechanism is applied using the example of the Russian Federation. The crisis state index is developed and its applicability for identifying pre-crisis and crisis states is proven. The novelty of the study consists in the fact that the universal model for assessing the crisis state based on economic indicators is developed.

Keywords

Crisis – Pre-crisis state – Principles – Assessment – Forecasting – Assessment mechanism

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Introduction

Modern society is rapidly changing under the influence of digital technologies[1]. Digitalization implies not only the implementation of software systems and high-tech equipment but also changes in business, processes, philosophy and management. Digitalization affects almost all spheres of society – political, economic and social[2].

In the challenging conditions of transforming economic relations and the absence of familiar boundaries under the influence of digitalization, it becomes necessary to improve the methodological support of crisis management. The problems of assessing and forecasting crises for various socio-economic systems (SES) are some of the priorities due to the acceleration of all processes and the need to quickly adapt to the changes[3]. The use of traditional econometric models significantly limits the evaluative and predictive capabilities of the concept of crises. Modern conditions require the development of new approaches to the assessment and forecasting of crises, including both deterministic and probabilistic relationships between various aspects of crises[4]. Within the study, we consider it necessary to develop and test a model for assessing and forecasting crises that would take into account macroeconomic processes. Recently, the number of works on crisis modeling and forecasting has increased. The special attention to this problem is caused by a sharp increase in the frequency and scale of financial imbalances in different countries[5]. The main goal of the study is to develop the crisis theory in the field of assessing and forecasting crisis phenomena, taking into account the existing realities of digitalization. As part of the analysis, we systematized modern principles and mechanisms for assessing and forecasting crisis phenomena and studied the possibilities of their application in modern conditions.

Methods

When forming hypotheses and setting goals, we relied on the basic provisions of the "Industry 4.0" concept which provided for end-to-end digitalization of all fields of work.

The provisions of theories of cyclical crises were used as a basis for systematizing the principles and mechanisms for assessing and forecasting crises.

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[1] J. Bloomberg, Digitization, Digitalization, And Digital Transformation: Confuse Them At Your Peril. Forbes, 2018. Retrieved from: www.forbes.com/sites/jasonbloomberg/2018/04/29/digitization-digitalization-and-digital-transformation-confuse-them-at-your-peril/#68e33c262f2c

[2] S. N. Grinyaev; A. N. Fomin; S. A. Kryukova y G. A. Makarenko, Metody prognozirovaniya srokov nastupleniya finansovo-ekonomicheskikh krizisov. Autonomous non-profit organization "Center for strategic assessment and forecasts". December 4, 2010. Retrieved from: http://csef.ru/media/articles/917/917.pdf y Crisis management and communications. Retrieved from: instituteforpr.org/crisis-management-and-communications/

[3] V. V. Pechatkin, “Formirovanie i razvitie tsifrovoi ekonomiki v Rossii kak strategicheskii prioritet razvitiya territorii v usloviyakh pandemii”, Voprosy innovatsionnoi ekonomiki num 2 (2020): 837-848 y E. A. Fainshmidt y T. V. Yureva, Zarubezhnaya praktika antikrizisnogo upravleniya, in: Educational and methodological complex (Moscow: Izd. tsentr EAOI, 2008).

[4] M. Yu. Malkina y A. O. Ovcharov, “Razvitie teorii finansovoi nestabilnosti i sovremennye problemy rossiiskoi ekonomiki”, Finansy i kredit Vol: 25 num 6(786): 1230-1248.

[5] V. S. Morozov y S. M. Shikirina, “Printsipy i etapy otsenki biznesa”, Vestnik universiteta num 11 (2014): 144-149 y T. A. Tereshonok, Rossiya: ot krizisa k ustoichivomu razvitiyu v usloviyakh tsifrovizatsii natsionalnoi ekonomiki, in: Tsifrovaya ekonomika: novaya paradigma razvitiya (Moscow: Otechestvo, 2018).

The development of a model for forecasting and assessing crises is based on the method of multifactor economic and mathematical modeling. When selecting indicators for the model, we used V.K. Senchagov's theory of economic security.

The methodological basis of the study consists of the general scientific methods of analysis, comparison, generalization, as well as theoretical and statistical methods.

Results

What is a crisis, why, how and when does one arise, what precedes a crisis and what are its consequences? Economists have been looking for answers to these questions for over two hundred years, since the beginning of the first economic crisis in England in 1788, and the crisis of 1825 was recognized by economists as a global economic crisis. Methods and mechanisms for assessing crises have changed and so have methods for forecasting crises but crises have occurred and will continue to occur in economic life. Therefore, the possibility and ability to assess and forecast crises are of scientific interest.

We understand the economic crisis as an extreme exacerbation in the economic system which affects other systems of society and threatens the viability of the economic and other systems in the environment.

The article features an analysis of the available literature containing a description of the principles and mechanisms for assessing and forecasting crises in the era of digitalization.

In this study, we understand principles as the basic starting position of any scientific system, theory, political structure, etc[6].

The analysis of the sources showed that the assessment of crises is based on the general methodological principles of assessment used in economic theory:

– subjectivity – any business entity influences other subjects of the world;

– rationalism – in this case, the main goal is to search for rational laws for the development of the entire economic system and, accordingly, help any business entity achieve its goal;

– empiricism – the correlation and patterns between phenomena and processes in the economy are revealed based on factual data about the real economy.

V.S. Morozov and S.M. Shikirina offer fundamental principles of assessment at the organizational level (Table 1)[7].

[6] Znachenie slova "Printsip", in: Collection of dictionaries Glosum. Retrieved from: https://glosum.ru/Значение-слова-Принцип

[7] V. S. Morozov y S. M. Shikirina, “Printsipy i etapy otsenki biznesa…

Name of the group of principles	Principles
Principles based on the owner's ideas	– the utility principle – the substitution principle – the anticipation (forecasting) principle
Principles related to using the property	– the investment principle – the additional productivity principle – the marginal productivity principle – the balance (proportionality) principle
Principles determined by the market environment	– the dependence principle – the correspondence principle – the demand and supply principle – the competition principle – the principle of change – the highest and best use principle

Table 1

Principles of assessment at the organizational level

The principles listed above are not used simultaneously. In each case, the main and auxiliary principles are identified.

Most authors consider crisis management principles in general. Below is an analysis of some of the sources.

Considering the assessment of the efficiency of crisis management, K.V. Kondrateva notes that the efficiency of management should be characterized by the achievement of management goals[8]. Moreover, the scholar pays great attention to specific performance indicators.

The criteria for assessing management efficiency have been examined in the works by Russian and foreign authors, including Ch. Barnard, M. Weber, G.V. Golikova, J. Gibson, L.I. Evenko, N.I. Kabushkin, I.Yu. Kalchina, S.N. Karaseva, E. Mayo, B.Z. Milner, A.Yu. Nesterov, F. Taylor, A.A. Khomyakova, Yu.V. Sheina and others[9].

In the study, K.V. Kondrateva describes the connection between crisis management principles and criteria for assessing efficiency (Table 2).

Crisis management principles	Criteria for assessing the efficiency
1) The principle of conformity of results with the purpose of the activity	1. Performance and financial efficiency
2) The principle of optimality of result-oriented performance	
3) The principle of adequate reaction and anticipatory action	2. Sustainability and adaptivity
4) The principle of permanent readiness for changes and urgent reaction	
5) The principle of innovative development	3. Innovativeness and innovative efficiency
6) The principle of scientificity	

[8] K. V. Kondrateva, “Otsenka effektivnosti antikrizisnogo upravleniya predpriyatiem”, Vestnik Permskogo universiteta. Ser. "Ekonomika" Vol: 4 num 31 (2016): 189–200.

[9] K. V. Kondrateva, “Otsenka effektivnosti antikrizisnogo upravleniya predpriyatiem…

7) The principle of systematicity and comprehensiveness of decisions made	4. The rationality of organizational structure, manageability and social efficiency
8) The principle of social efficiency	
9) The principle of priority use of own resources and cost-effectiveness	5. Efficiency of management and its cost-effectiveness
10) The principle of professionalism	

Table 2
The connection between crisis management principles
and the criteria for assessing the efficiency

According to E.M. Korotkov, crisis management principles are[10]:

– crises can be predicted, accelerated, postponed and mitigated;

– crisis processes can be controlled;

– one must prepare for crises (creation of anti-crisis groups, resources).

A.G. Gryaznova identifies the following principles of crisis management[11]:

– early detection of crisis phenomena in the activities of SES;

– timely response to crisis phenomena;

– the adequacy of the management's response to the degree of the real threat of the crisis to the social and economic development of the SES;

– full mobilization and implementation of inherent capabilities for the exit of the SES (organization) from the crisis state.

The book "Foreign practice of crisis management" contains several principles that allow one to efficiently deal with crisis phenomena not only at the level of the economy within a single enterprise but also at the state level[12]:

– early detection of crisis phenomena;

– immediate reaction;

– adequate reaction;

– mobilization of the company's inherent potential.

All authors agree that crises must be anticipated.

[10] E. M. Korotkov, Antikrizisnoe upravlenie + dopmaterialy v EBS.: university textbook (Moscow: Izdatelstvo Yurait, 2020); A. S. Krylov, “Prognozirovanie finansovykh krizisov na osnove operezhayushchikh indikatorov”, Audit i finansovyi analiz num 4 (2013): 117-125 y E. A. Fainshmidt y T. V. Yureva, Zarubezhnaya praktika antikrizisnogo upravleniya…

[11] V. G. Pluzhnikov y S. A. Shikina, Antikrizisnoe upravlenie (Chelyabinsk: Izdatelskii tsentr YuUrGU, 2016)

[12] V. K. Senchagov; S. N. Mityakov; E. S. Mityakov y N. A. Romanova, Ekonomicheskaya bezopasnost regionov Rossii: a monograph (Nizhnii Novgorod: Nizhny Novgorod State Technical University n.a. R.E. Alekseev, 2012)

Some authors believe that it is possible to predict crises in some cases (when crises occur due to changes that we can and have time to understand and evaluate), in others, it is not[13].

L.Yu. Shipovich provides the general sequence of actions for crisis forecasting[14]:

1) determine goals and time limits for forecasting crises;

2) understand the reasons, essence and nature of this crisis;

3) determine obsolete and, conversely, promising elements of the system and identify the core of the future system;

4) establish the field (area) affected by the crisis;

5) study the external factors of the development of a future crisis, the interaction of cycles, their synchronization and resonant influence;

6) consider the ways out of the crisis, analyze several options for overcoming the crisis in different conditions, one of the options is accepted as the main one;

7) recognize the errors in the forecast to make adjustments in time, to respond to previously unknown factors;

8) analyze the lessons of the crisis.

D.A. Novikov classifies forecasting as a kind of research, analytical and cognitive activity. The principles of research activities applied to forecasting crises include[15] the principle of integrity, the principle of compatibility of the elements of the whole, the principle of the functional and structural formation of the whole, the principle of development, the principle of polyfunctionality, the principle of iteration, the principle of probabilistic estimates, the principle of variance, the unity of theory and practice[16].

The principles are interdependent, and the complex application of the principles provides the methodological integrity of the crisis forecasting processes.

The scholar supplements the presented list of principles:

1) system integrity of the forecasting mechanism;

[13] N. I. Didenko; D. F. Skripnyuk y K. N. Kikkas, “Globalnaya ekonomika: analiz i otsenka krizisov. Nauchno-tekhnicheskie vedomosti Sankt-Peterburgskogo gosudarstvennogo politekhnicheskogo universiteta”, Ekonomicheskie nauki Vol: 1 num 39 (2012): 23-34 y Mekhanizm krizisa na makrourovne. Economuch.com. 2012. Retrieved from: https://economuch.com/ekonomicheskaya-teoriya/mehanizm-krizisa-makrourovne-52959.html

[14] L. Yu. Shipovich, “Sushchnost, prichiny i posledstviya vozniknoveniya krizisnykh situatsii v Rossii”, Vestnik Chelyabinskogo gosudarstvennogo universiteta Vol: 6 num 187 (2010): 16-19.

[15] D. A. Novikov, “Sovershenstvovanie printsipov i sredstv prognozirovaniya krizisnykh situatsii v razvitii organizatsii”, Rossiiskoe predprinimatelstvo num 8 (2011): 44-49.

[16] V. G. Pluzhnikov, S.A. Shikina, Antikrizisnoe upravlenie… y Crisis management and communications…

2) a comprehensive consideration of all key areas of the organization's development and all groups of crisis factors;

3) the use of a set of forecasting methods that are most relevant at each of the stages and for each of the subtasks of a multi-iterative study;

4) a combination of quantitative and qualitative methods and assessments in the framework of predictive research, a combination of a search-based and normative approach to forecasting to identify crises of various nature;

5) flexibility and adaptability in forecasting, taking into account the specific nature of the enterprise;

6) impartiality, independence of research;

7) no restrictions in the process of forming assumptions;

8) a combination of completeness of the final reporting information and compactness and clarity when communicating the results to the management;

9) multivariance of forecasts, consideration of the probabilistic nature of the initial factors and final forecasts;

10) flexibility and the possibility of integration into the information subsystem of the organization as an addition to the existing processes of controlling, risk management and strategic planning;

11) the economic efficiency of research.

The proposed list of principles for forecasting crises in the development of an organization includes the main provisions of the research principles and also takes into account the actual needs of the specific tasks of crisis management of the organization. In the work, the author focuses on the principles of crisis management at the organization level.

The most complete list of forecasting principles is given by J. Scott Armstrong in the book "PRINCIPLES OF FORECASTING: A Handbook for Researchers and Practitioners"[17]. The author identified the problem of insufficient attention to deliberate forecasting (initial assessment, role-playing games, intentions, expert opinions). Most sources describe statistical methods without showing their connection to forecasting principles. Jim Cox and Dave Loomis note that only one-fifth of forecasting principles are mentioned in a regular forecasting textbook[18]. The principles proposed by J. Scott Armstrong are divided into 16 groups (Tables 3–5).

[17] J. Sc. Armstrong, Principles of forecasting: A Handbook for Researchers and Practitioners (Kluwer Academic Publishers (Netherlands), 2001).

[18] J. Sc. Armstrong, Principles of forecasting...

Group of forecasting principles	Forecasting principles
1) The principles of setting goals	1.1 Describe solutions that may be affected
	1.2 Coordinate actions for different forecasts
	1.3 Make the forecast independent from organizational policy
	1.4 Check if an event or series of events can be forecast
	1.5 First, get the agreement of those who made decisions on methods
2) The principles of structuring problems	2.1 Determine possible outcomes before making a forecast
	2.2 Decide on the level of data aggregation
	2.3 Perform problem decomposition
	2.4 Take into account causal relationships when forming time series
	2.5 Structure issues that involve communication
	2.6 Structure issues that involve causation
	2.7 Expand time series by level and trend
3) The principles of identifying sources of information	3.1 Use theory to find information about causal variables
	3.2 Ensure the consistency of data with the forecast situation
	3.3 Avoid biased data sources
	3.4 Use a variety of data sources
	3.5 Obtain information from similar cases
4) The principles of collecting data	4.1 Use objective and systematic procedures to collect data
	4.2 Ensure input reliability
	4.3 Ensure information is accurate
	4.4 Obtain all important data
	4.5 Avoid collecting irrelevant data
	4.6 Obtain the most recent data
5) The principles of preparing data	5.1 Clear data
	5.2 Use transformations as expected
	5.3 Avoid discrete time series
	5.4 Determine unexpected events in the past
	5.5 Establish systematic events (e.g. seasonality)
	5.6 Use multiplier factors for a range of trends when good estimates for seasonal factors can be obtained
	5.7 Alleviate seasonal factors of uncertainty
	5.8 Use graphical presentation of data
6) The principles of choosing methods	6.1 List all important criteria
	6.2 Conduct expert assessments for the selection of methods
	6.3 Use structured forecasting techniques
	6.4 Priority of quantitative over qualitative forecasting methods
	6.5 Use methods that consider causation
	6.6 Choose simple methods unless evidence supports complex ones
	6.7 The forecasting method should be appropriate for the situation
	6.8 Compare the "track record" of different methods
	6.9 Evaluate the acceptability and clarity of methods for users
	6.10 Explore the value of alternative methods

Table 3
Forecasting principles (1–6)

Group of forecasting principles	Forecasting principles
7) General implementation methods	7.1 Keep methods simple
	7.2 Ensure a realistic representation of the forecast situation
	7.3 Be conservative in situations of uncertainty or instability
	7.4 Do not predict cycles
	7.5 Adjust for anticipated future events
	7.6 Combine similar data types
	7.7 Ensure consistency with related series forecasts
8) Application of assessment methods	8.1 Test questions used to generate estimated predictions
	8.2 Use alternative questions
	8.3 Ask experts to justify their predictions
	8.4 Use numeric scales with multiple categories
	8.5 Receive forecasts from heterogeneous experts
	8.6 Obtain predictions of intentions or expectations from representative samples of participants
	8.7 Obtain forecasts from a sufficient number of respondents
	8.8 Receive multiple evaluations of an event from each expert
9) Implementation of qualitative methods	9.1 Adapt the forecasting model to the horizon
	9.2 Check model against the basic process
	9.3 Do not use "fitting" when developing a model
	9.4 Give more weight to the most relevant data
	9.5 Update models frequently
10) Implementation methods: qualitative models with independent variables	10.1 Use theory and subject-specific experience to select random variables
	10.2 Use all important variables
	10.3 Use theory and subject-specific experience to identify trends
	10.4 Use theory and subject-specific experience to assess/restrict connections
	10.5 Use different types of data to evaluate connections
	10.6 Forecast for at least two alternative environments
	10.7 Forecast for alternative actions
	10.8 Apply the same principles to forecasting explanatory variables
	10.9 Considering forecasts of explanatory variables, reduce (decrease) forecasts of changes
11) Integration of evaluative and quantitative methods	11.1 Use structured procedures
	11.2 Use structured judgment
	11.3 Use predetermined subject-specific knowledge as input for selection, weighting and modification of quantitative methods
	11.4 Limit subjective adjustments
	11.5 Use quantitative estimates instead of expert forecasts
12) Combination of forecasts	12.1 Combine forecasts from different approaches
	12.2 Use multiple approaches, preferably at least five
	12.3 Use formal procedures to combine forecasts
	12.4 Start with equal weights
	12.5 Use cropped tools

	12.6 Use evidence of the accuracy of each method to change the weights of the forecast components
	12.7 Use subject-specific knowledge to vary the weights in component predictions
	12.8 Combine when there is great uncertainty about the best method
	12.9 Combine when there is uncertainty about the situation
	12.10 Combine when it is important to avoid big mistakes

Table 4
Forecasting principles (7–12)

The group of principles on assessment techniques (group 13) is the largest. It includes the following principles:

13.1 Compare the adequacy of methods

13.2 Use educated hypotheses

13.3 Design a test situation for comparison with the forecasting problem

13.4 Describe the conditions associated with the forecasting problem

13.5 Adapt the analysis to the solution

13.6 Describe possible assumptions by forecasters

13.7 Evaluate the reliability and validity of the data

13.8 Provide easy access to data

13.9 Provide full disclosure of methods

13.10 Check assumptions for validity

13.11 Check customer understanding

13.12 Use direct replication of assessments to identify errors

13.13 Use replication of forecast assessments to evaluate the reliability

13.14 Determine the scope of acceptable ranges for the application of assessments

13.15 Conduct extended assessments in real-life situations

13.16 Compare forecasts obtained by different methods

13.17 Examine all important criteria

13.18 Indicate criteria before analysis

13.19 Assess the qualifications of experts

13.20 Determine the range of admissible deviations

13.21 Verify that deviation measures are acceptable

13.22 Avoid estimating errors that depend on the degree of difficulty in forecasting

13.23 Avoid biased measurement

13.24 Avoid measurement errors with high sensitivity to outliers

13.25 Use multiple criteria for accuracy

13.26 Use out-of-sample measures of error (expected)

13.27 Use a post factum accuracy test to assess the efficiency

13.28 Do not use corrected R-square to compare models

13.29 Use statistical significance only to compare the accuracy of reasonable methods

13.30 Do not use standard deviations for comparisons

13.31 Make basic comparisons on a large sample

13.32 Conduct clear cost-benefit assessments.

Group of forecasting principles	Forecasting principles
14) Assessment of uncertainty	14.1 Estimate prediction intervals (PI) 14.2 Use objective procedures 14.3 Improve PI using a realistic representation of the situation 14.4 Use transformations to estimate symmetric PI 14.5 Ensure consistency over the forecast horizon 14.6 List the reasons why the forecast may be wrong 14.7 Consider the likelihood of alternative outcomes when evaluating PI 14.8 Get good feedback for better calibration of PI 14.9 Combine PI obtained by different methods 14.10 Use reliable facts 14.11 Conduct experiments 14.12 Do not evaluate uncertainty in a traditional group meeting
15) Forecast presentation	15.1 Provide a clear summary of forecasts and data 15.2 Give a clear explanation of the methods 15.3 Describe assumptions 15.4 Forecast of current point and PI 15.5 Present forecasts as scenarios
16) Learning	16.1 Consider using adaptive models 16.2 Search forecast reviews 16.3 Use a formal review process for forecasting methods 16.4 Use a formal review process to use forecasts

Table 5

Forecasting principles (14–16)

A system of distinctive features in assessing and forecasting crises in the context of digitalization

Let us propose a system of basic parameters that should be taken into account when assessing and forecasting crises according to the "Industry 4.0" concept:

- increasing organizational complexity in the production system;

- complication of the decision-making process ("the decision-making process is becoming more complex as a result of a huge number of alternatives and multiple conflicting goals);

- changed business models 4.0;

- distributed end-to-end nature of work (projects);

- "high dependence on the sturdiness of technologies and networks, when small disruptions can lead to serious consequences";

- the potential loss of control over the enterprise due to virus attacks;

- decentralized management;

- the reliance only on state industrial statistics is not efficient enough since, at present, the methodological base and system of indicators corresponding to the concept of "Industry 4.0"[19] are not yet operational. According to experts, the lack of a generally accepted methodology for assessing the digital economy in Russia contributes to the use of the experience of several international organizations[20].

Let us propose a universal model for assessing the pre-crisis state which can be supplemented with crisis indicators. In the context of digitalization, the economy must respond more quickly to the signals of indicators about the impending crisis. This model should significantly accelerate the response to crisis changes in the economy and, accordingly, take anti-crisis measures faster.

Based on the principles, a mechanism for assessing and forecasting crisis phenomena is developed.

The concept of a mechanism (from the Greek *mechane* – tool, machine) has several definitions: 1. sequence of states, processes that determine any action, phenomenon; 2. a system, device that determines the order of some kind of activity; 3. the internal structure (system of links) of a machine, device or apparatus that drives them[21].

[19] The 2024 Federal State Statistic Service Development Strategy. Retrieved from: https://rosstat.gov.ru/strategy

[20] A. S. Abroskin, Yu.K. Zaitsev, G.I. Idrisov, Ekonomicheskoe razvitie v tsifrovuyu epokhu (Moscow: Izdatelskii dom "Delo" RANKhiGS, 2019).

[21] B. N. Gerasimov, “Mekhanizm vzaimodeistviya elementov organizatsii”, Problemy teorii i praktiki upravleniya num 1 (2019): 101-108.

B.N. Gerasimov examines the general management mechanism within an organization. According to the author, to build any mechanism, all elements and processes of the organization must be connected. As a result, there is an enlarged system-process model of the organization. The following operations are proposed to transform the model into a mechanism.

1) Indicators are identified that should be monitored to determine the state of the organization and its management system.

2) These indicators are analyzed and compared with the expected (planned) results. Normative values can be introduced in accordance with legislative and regulatory acts, economic and mathematical methods, foreign experience in the industry in question or national and global sectoral values[22].

3) Based on this study, the means of managerial influence are chosen and implemented in the right place at the right time.

The main goal of the economic mechanism of any level is to register, at certain intervals, the results of the activity of the research object, identify its state and components according to the given indicators and develop a range of management influences on the control system or its individual elements in the appropriate place.

In general, the process of developing a management mechanism can also be used to track crisis phenomena not only at the enterprise level but also at the regional, national and global levels. Differences will manifest when choosing indicators[23].

Within the framework of crisis management at the organization level, these can be the most important economic (income, profit, profitability), socio-economic (number of staff, turnover), social (staff satisfaction, organization image) and other indicators of the organization's performance[24].

At the regional level, all indicators can also be divided into groups. To identify the crisis states in the regions, one can use, for example, indicators of the economic security of regions[25]:

1) economic: gross regional product (GRP) per capita, annual inflation rate, investment in equity, the degree of depreciation of fixed assets of industrial enterprises, the foreign trade surplus, the surplus of the consolidated budget of the region;

[22] D. A. Kornilov, Zolotovalyutnye rezervy stran kak odin iz faktorov finansovoi bezopasnosti, in: Ekonomicheskaya bezopasnost Rossii: problemy i perspektivy (Nizhnii Novgorod: Nizhny Novgorod State Technical University n.a. R.E. Alekseev, 2016)

[23] D. A. Kornilov; N. I. Yashina; S. N. Yashin; N. N. Pronchatova-Rubtsova y I. S. Vinnikova, Diagnosing changes in financial and economic indicators of the EU countries and the Russian Federation in crisis. Journal of Advanced Research in Law and Economics Vol: 9 num 4(34) (2018): 1302-1311.

[24] B. N. Gerasimov, “Mekhanizm vzaimodeistviya elementov organizatsii… y Crisis Management – 7 Steps to Manage a Crisis. Retrieved from: www.reputationmanagement.com/blog/crisis-management/

[25] V. K. Senchagov; S. N. Mityakov; E. S. Mityakov y N. A. Romanova, Ekonomicheskaya bezopasnost regionov Rossii…

2) social: the ratio of the average per capita income to the subsistence level, the ratio of the average pension to the average wage, the unemployment rate, life expectancy at birth, the size of housing per inhabitant, funds for health care, education and social policy;

3) innovative: the share of shipped innovative products in all shipped industrial products, the number of people engaged in research and development, internal costs for research and development, the intensity of costs for technological innovation, the number of applications for inventions and utility models;

4) environmental: discharge of contaminated liquid waste, emissions of pollutants into the air from stationary sources, reforestation.

Table 6 contains possible crisis indicators at the state level[26].

Indicators of the real sector of the economy	Indicators of the social sphere
1) Gross domestic product (GDP), billion rubles. 2) average annual GDP growth rates, % 3) the annual share of GDP allocated to national defense, % 4) expenditures on civil science, % of GDP 5) the annual share of GDP allocated to state security, % 6) the volume of investments in equity, % of GDP 7) the share of production of machinery and equipment, power equipment, optical equipment and vehicles, and equipment in the total volume of shipped products and services, % 8) grain harvest, million tons 9) the share of innovative products in all shipped products, % 10) the ratio of mineral reserves to the volume of their production, %	1) average life expectancy (men, women), years 2) the average estimated number of children per woman 3) the ratio of the number of people of retirement and working age 4) funds for health care, education and culture, % of GDP 5) the proportion of the population with incomes below the subsistence level 6) the ratio of the average pension to the average wage, % 7) the funds coefficient (the ratio of incomes of 10% of high-income and 10% of the population with low incomes), times 8) the ratio of the average per capita monetary income to the subsistence level, times 9) unemployment rate according to the International Labor Organization (ILO) methodology, % 10) housing area per inhabitant, square meters
Indicators of the monetary and finance sphere	Indicators of the foreign economy

[26] V. K. Senchagov; S. N. Mityakov; E. S. Mityakov y N. A. Romanova, Ekonomicheskaya bezopasnost regionov Rossii…

1) the total amount of foreign exchange reserves at the end of the year, billion dollars 2) annual inflation rate, % 3) the level of monetization of the economy: M2 at the end of the year, % of GDP 4) authorized capital of banks at the end of the year, % of GDP 5) bank investments under state and state-guaranteed commitments, % of all investments in debt obligations 6) volume of loans, % of GDP 7) loan defaults in the total volume of consumer and mortgage loans, % 8) daily fluctuations of the stock market index, % 9) non-residents in the total assets of the banking system, % 10) federal budget surplus, % of GDP 11) the share of expenses for servicing and repayment of the state debt in the total volume of federal budget expenditures, %	1) the share of imported food, % 2) the ratio of the size of the national foreign and internal debt to GDP, % 3) the ratio of the amount of foreign state and corporate debt at the end of the year to the annual volume of exports, % 4) foreign trade surplus, % of GDP

Table 6
Crisis indicators at the state level

When forecasting crises, the authors[27], propose the following as a system of leading indicators of the global level: the state of the budget of the United States of America, stock indices, the state of commodity markets, the price of gold and oil and the US dollar rate against other world currencies[28].

This mechanism is focused on determining the state of indicators individually and as a whole, as well as all or individual aspects of the activities of controlled objects.

Some authors speak about the growing impact of digital transformation on the socio-economic processes of the country and, as some of the indicators that also require attention, highlight the information and communication technologies (ICT) Development Index, the Global Innovation Index (GII), the Network Readiness Index, the share of households with internet access and the export of high technologies[29].

The industrial adoption of the Internet of Things can lead to economic and social transformation; an increase in the number of connected machines and objects by 10% can

[27] S. N. Grinyaev; A. N. Fomin; S. A. Kryukova y G. A. Makarenko, Metody prognozirovaniya srokov… y F. F. Yurlov; D. A. Kornilov; A. F. Plekhanova y A. S. Uzbekova, Sotsialno-ekonomicheskoe prognozirovanie (Nizhnii Novgorod: Nizhny Novgorod State Technical University n.a. R.E. Alekseev, 2010).

[28] D. A. Kornilov, Zolotovalyutnye rezervy stran kak odin iz faktorov finansovoi bezopasnosti…

[29] K. N. Gorlov y M. V. Ilicheva, "Tsifrovizatsiya kak osnova ustoichivogo razvitiya regiona: sotsialno-politicheskii i ekonomicheskii aspekty", Izvestiya Tulskogo gosudarstvennogo universiteta. Gumanitarnye nauki num 4 (2018): 42-50 y Crisis management and communications…

lead to an annual increase in GDP by 0.7%[30]. Elements of Industry 4.0, on the one hand, play a positive role in the advancement of information technology which contributes to the sustainable operation of a business and, on the other hand, entail risks and costs[31].

The digital economy is analyzed according to four criteria: the employment sector, the level of penetration, technology and the cost factor[32].

One of the elements of the crisis management mechanism is crisis management methods and in particular methods of their assessment and forecasting. When forecasting crisis phenomena, the most common approaches are based on mathematical models and leading indicators[33].

In the book "Methods of predicting the timeframe for financial and economic crises", the authors characterize the methods of mathematical modeling as some of the most common in modeling and highlight the paradoxes of their application[34]:

1) any mathematical model is based on certain assumptions that do not change over time about the conditions for the functioning of the system under study;

2) one must often abandon the development of a very detailed mathematical model in favor of a model with a small number of components while losing the advantages of a more detailed analysis.

Speaking of paradoxes, when developing methods for forecasting financial and economic crises, researchers encourage one to focus on leading indicators of various levels (global, national). To prevent global crises, scholars urge to pay more attention to the issues of anti-crisis stability of the global financial system.

The study of the source[35] makes it possible to supplement the previously listed principles of forecasting crises with the following:

1) the principle of the reliability of the system of initial data for previous periods;

2) a clear unambiguous designation of the goal;

[30] K. N. Gorlov y M. V. Ilicheva, “Tsifrovizatsiya kak osnova ustoichivogo razvitiya regiona… y M. A. Afonasova; M. E. Galichkina; E. E. Panfilova y B. Ślusarczyk, “Digitalization in Economy and Innovation: The Effect on Social and Economic Processes”, Polish Journal of Management Studies Vol: 19 num 2 (2019).

[31] M. Graham; I. Hjorth y V. Lehdonvirta, “Digital labour and development: impacts of global digital labour platforms and the gig economy on worker livelihoods”, Transfer: European Review of Labour and Research Vol: 23 num 2 (2017).

[32] M. A. Afonasova; M. E. Galichkina; E. E. Panfilova y B. Ślusarczyk, “Digitalization in Economy… y J. J. Kirton y B. Warren, “G20 Governance of Digitalization”, International organisations research journal num 2 (2018).

[33] S. N. Grinyaev; A. N. Fomin; S. A. Kryukova y G. A. Makarenko, Metody prognozirovaniya srokov…; N. I. Didenko; D. F. Skripnyuk y K. N. Kikkas, “Globalnaya ekonomika… y F. F. Yurlov; D. A. Kornilov; A. F. Plekhanova y A. S. Uzbekova, Sotsialno-ekonomicheskoe prognozirovanie…

[34] S. N. Grinyaev; A. N. Fomin; S. A. Kryukova y G. A. Makarenko, Metody prognozirovaniya srokov…

[35] S. N. Grinyaev; A. N. Fomin; S. A. Kryukova y G. A. Makarenko, Metody prognozirovaniya srokov…

3) a rational degree of structuring when creating a mathematical model of a dynamic system. If the initial information is corrupted or has a high degree of uncertainty, then the modeling result will be largely uncertain;

4) the principle of data objectivity;

5) the principle of complementarity of leading indicators. Indicators should not be limited to a single complex indicator, rather they should be used on a complimentary basis. One should consider expert data in addition to numerical information.

In the calculation part of the study, we will use the empirical principle for the mechanism for assessing and forecasting crises in the economy. The history of economic crises dates back to 1788 (the crisis in the textile industry). The global economic crisis happened in 1825 in England. Some economists interpret it as the first international financial crisis, some call it the first periodic crisis, but all economists agree that this crisis was indeed a crisis. Since at that time capitalism was the dominant system in England, many economists (K. Ricardo, J. Mill, K.-B. Say) believed that economic crises were impossible under capitalism, or they were random, and the market could overcome economic crises independently. This may have been because the first crisis was witnessed only by K.-B. Say and J. Mill. Therefore, these economists concluded that crises occurred by chance. Although K. Marx at the same time already studied the causes of crises and substantiated their regularity. However, after the crises began to occur time and again, and the next crisis occurred in 1836 in Great Britain and the USA, the crisis of 1847 already affected the countries of Europe, as well as North and South America. The next crisis of 1873-1878 was the longest, although it affected only some European countries and the USA. Then crises continued, and the question of the causes of crises and their patterns arose before economists, and various theories began to appear explaining the causes of crises. The world community today faces the challenge of identifying a crisis in advance to avoid or prevent it as much as possible or at least reduce losses. The global economy has always been prone to crises, not only in the 21st century but long before that, and the Russian economy in this case is no exception. Many economists at different times tried to identify the relationship between certain markers (data, indicators) and the onset of the crisis, some indicators remain unchanged and are indicators of crisis phenomena, and some indicators are added depending on the time and nature of the origin of the crisis. In 2020, during the pandemic announced by the World Health Organization (WHO), social and psychological indicators were added to economic indicators. According to the project summary of the "Digital Economy of the Russian Federation" program, there are several measures aimed at implementing the following key areas of transformation in the economy and social sphere: the formation of a new regulatory environment for inter-citizen relations between citizens, business and the state arising with the development of the digital economy, the creation of a modern high-speed infrastructure for data storage processing and transmission, ensuring the stability and security of its functioning, formation of a staff training system for the digital economy, support of the development of promising "end-to-end" digital technologies and projects for their implementation, improvement of the efficiency of public administration and public service provision through the introduction of digital technologies and platform solutions[36]. According to this document, several indicators must be achieved, namely:

[36] Ministry of Digital Development, Communications and Mass Media of the Russian Federation. Retrieved from: https://digital.gov.ru/uploaded/files/natsionalnaya-programma-tsifrovaya-ekonomika-rossijskoj-federatsii_NcN2nOO.pdf

- the share of the Russian Federation in the global volume of services for storing and processing data in 2017 was 0.9%, and by 2024 it should be 5.0%;

- the cost share of Russian software purchased and (or) leased by federal executive authorities, executive authorities of federal subjects and other state authorities in 2017 was 0%, and by 2024 it should be 90%;

- the cost share of Russian software purchased and (or) leased by state corporations, companies with state participation in 2017 was 0%, and by 2024 it should be 70%.

In the era of digitalization of the Russian economy, when it is possible to process huge amounts of data (Big Data), one can predict the onset of crises using mathematical models through certain indicators.

According to our hypothesis, some economic indicators will behave similarly (decrease or increase a year before, or two or three years before the crisis). We will evaluate these indicators by analyzing the trend of indicators and, if necessary, reflect this graphically.

Let us consider the following indicators which we will classify as economic indicators:

- the GDP growth rate,

- change in the GDP deflator,

- the pace of inflation,

- change in real interest rates,

- trend of investments in equity,

- unemployment rate,

- growth rate of the monetary aggregate M2.

The first and most important indicator is the GDP growth rate. GDP is one of the most important indicators of the entire economy but if we look at the value of GDP (presented in Table 7), we will see that this indicator tends only to grow, i.e. does not react in any way to the pre-crisis state or the crisis state. Therefore, we decided to turn to the GDP growth rate which is presented in Table 7[37].

Year	GDP, billion roubles	GDP growth rate, %
2000	7,305.6	
2001	8,943.6	122.42
2002	10,830.5	121.10
2003	13,208.2	121.95
2004	17,027.2	128.91
2005	21,609.8	126.91

[37] Valovoi vnutrennii product. Federal State Statistic Service. Retrieved from: https://rosstat.gov.ru/storage/mediabank/tab1(2).htm y Federal State Statistic Service. Retrieved from: https://www.gks.ru/storage/mediabank/rab_sila18.pdf

2006	26,917.2	124.56
2007	33,247.5	123.52
2008	41,276.8	124.15
2009	38,807.2	94.02
2010	46,308.5	119.33
2011	60,114.0	129.81
2012	68,103.4	113.29
2013	72,985.7	107.17
2014	79,030.0	108.28
2015	83,087.4	105.13
2016	85,616.1	103.04
2017	91,843.2	107.27
2018	104,629.6	113.92
2019	110,046.1	105.18

Table 7
GDP trend (current prices) in Russia from 2000 to 2019

The table shows that a year or two before the crisis, the GDP growth rate tends to decrease. This is evidenced by the data before the crisis in 2004 (the decline begins in 2001), before the crisis in 2008 (the decline was observed since 2004), before the crisis in 2014-2015 (a decrease was observed since 2012) and before the crisis of 2020 (a decrease was observed since 2018). Therefore, one can conclude that one of the indicators of a crisis or pre-crisis state is the GDP growth rate.

The trend of the GDP deflator index as a percentage of the previous year, the GDP deflator is designed to recalculate the monetary economic indicators of the base period for the value level of a specific period.

Let us check whether the GDP deflator index is one of the main indicators of a pre-crisis or crisis state. Table 8 shows the trend of the GDP deflator index in Russia for 2000-2019[38].

This table also contains the consumer price index which measures the change over time in the cost of a set of food, non-food goods and services consumed by an average household (consumer basket)[39].

Year	The GDP deflator index as a percentage of the previous year	The consumer price index, %
2000	137.6	120.18
2001	116.5	118.58
2002	115.6	115.06
2003	113.8	111.99
2004	120.3	111.73
2005	119.3	110.92
2006	115.2	109.00
2007	113.8	111.87

[38] Valovoi vnutrennii produkt godovye dannye (indeksy-deflyatory, v % k predydushchemu godu). Federal State Statistic Service. Retrieved from: https://rosstat.gov.ru/storage/mediabank/tab4(2).htm y Znachenie slova "Printsip"…

[39] Indeksy potrebitelskikh tsen. Federal State Statistic Service. Retrieved from: https://www.gks.ru/storage/mediabank/8Fbbwck1/Индексы%20потребительских%20цен%20по%20Российской%20Федерации.html

2008	118.0	113.28
2009	102.0	108.80
2010	114.2	108.78
2011	115.9	106.10
2012	108.9	106.57
2013	105.3	106.47
2014	107.5	111.35
2015	107.2	112.91
2016	102.8	105.39
2017	105.3	102.51
2018	111.1	104.26
2019	103.8	103.04

Table 8
The trend of the GDP deflator index as a percentage of the previous year and the consumer price index in Russia for 2000-2019

Therefore, the GDP deflator indices before the crises of 2004, 2008, 2014-2015 and 2020 have a downward trend as evidenced by the data in Table 8. Based on Table 8, we conclude that this indicator is informative and is an indicator of the pre-crisis state. The data in Table 8 also indicate that in the one to two years preceding the crisis, the consumer price index has grown. We see an increase in the consumer price index since 2006 before the 2008 crisis, in 2013 before the 2014-2015 crisis and in 2018 before the late 2019 and early 2020 crisis. The consumer price index is also an informative indicator; therefore. it is an indicator of the pre-crisis and crisis state.

Let us consider the trend of investment in equity presented in Table 9[40].

Year	Investment in equity, million roubles	Trend of investment in equity in comparable prices	Growth rate of investment in equity, %
2000	1,165,234.2	117.4	
2001	1,504,712.1	111.7	129.13
2002	1,762,407.3	102.9	117.13
2003	2,186,365.2	112.7	124.06
2004	2,865,013.9	116.8	131.04
2005	3,611,109	110.2	126.04
2006	4,730,022.9	117.8	130.99
2007	6,716,222.4	123.8	141.99
2008	8,781,616.4	109.5	130.75
2009	7,976,012.8	86.5	90.83
2010	9,152,096	106.3	114.75
2011	11,035,652	110.8	120.58
2012	12,586,090.4	106.8	114.05
2013	13,450,238.2	100.8	106.87
2014	13,902,645.3	98.5	103.36
2015	13,897,187.7	89.9	99.96
2016	14,748,846.9	99.8	106.13
2017	16,027,302	104.8	108.67
2018	17,782,012.3	105.4	110.95
2019	19,318,812	101.7	108.64

Table 9
The trend of investment in equity in Russia from 2000 to 2019

[40] Investitsii v nefinansovye aktivy. Federal State Statistic Service. Retrieved from: https://www.gks.ru/investment_nonfinancial

Therefore, the indicators associated with equity investments cannot serve as indicators of a pre-crisis or crisis state as these indicators behave differently, sometimes decreasing, then growing before a crisis state. Therefore, we will not use this indicator as an informative one.

The next indicator, which, in our opinion, may be an indicator of a crisis or pre-crisis state is the real interest rate. This indicator represents the lending interest rate adjusted for inflation which is calculated using the GDP deflator. Table 10 shows the trend of the real interest rate in Russia from 2000 to 2018[41]. Table 10 also shows the trend of the unemployment rate in Russia. Since the unemployment rate shows the share of the unemployed in the total size of the labor force, let us consider how it manifests itself in the pre-crisis state[42].

Year	Real interest rate	Unemployment rate
2000	-9.63	10.6
2001	1.23	9.0
2002	0.03	7.9
2003	-0.60	8.2
2004	-7.33	7.8
2005	-7.21	7.2
2006	-4.08	7.2
2007	-3.34	6.1
2008	-4.9	6.3
2009	13.08	8.4
2010	-2.26	7.5
2011	-12.86	6.5
2012	0.18	5.7
2013	3.94	5.5
2014	3.4	5.2
2015	7.89	5.6
2016	9.48	5.5
2017	4.95	5.2
2018	2.01	4.8
2019	2.0	4.6

Table 10

The trend of the real interest rate and the unemployment rate in Russia from 2000 to 2019. Unemployment rate 2000-2009, 2010-2018

From table 10 we see that the real interest rate is also not an indicator of the crisis and pre-crisis state of the economy.

At the same time, the unemployment rate before the crisis decreases and rises after the crisis. Therefore, we will also consider this indicator informative for assessing the pre-crisis and crisis states.

[41] Knoema. Retrieved from: https://knoema.ru/atlas/Российская-Федерация/topics/Экономика/Финансовый-сектор-Процентные-ставки/Реальная-ставка-процента

[42] Unemployment rate (percentage). Federal State Statistic Service. Retrieved from: https://rosstat.gov.ru/bgd/regl/b10_14p/IssWWW.exe/Stg/d01/04-15.htm y Federal State Statistic Service…

According to some economists, one of the indicators of the crisis and pre-crisis state is the monetary aggregate M2, the trend of this indicator is presented in Table 11[43].

At beginning of the year	Monetary aggregate M2	Growth rate	Relative share of M2
2000	714.6		
2001	1,150.6	161.01	37.24
2002	1,609.4	139.87	36.41
2003	2,130.5	132.38	36.27
2004	3,205.2	150.44	35.82
2005	4,353.9	135.84	35.3
2006	6,032.1	138.54	33.3
2007	8,970.7	148.72	31
2008	12,869.0	143.46	28.8
2009	12,975.9	100.83	29.2
2010	15,267.6	117.66	26.4
2011	20,011.9	131.07	25.3
2012	24,204.8	120.95	24.5
2013	27,164.6	112.23	23.7
2014	31,155.6	114.69	22.4
2015	31,615.7	101.48	22.7
2016	35,179.7	111.27	20.6
2017	38,418.0	109.21	20.1
2018	42,442.2	110.47	19.9
2019	47,109.3	111.00	19.8

Table 11

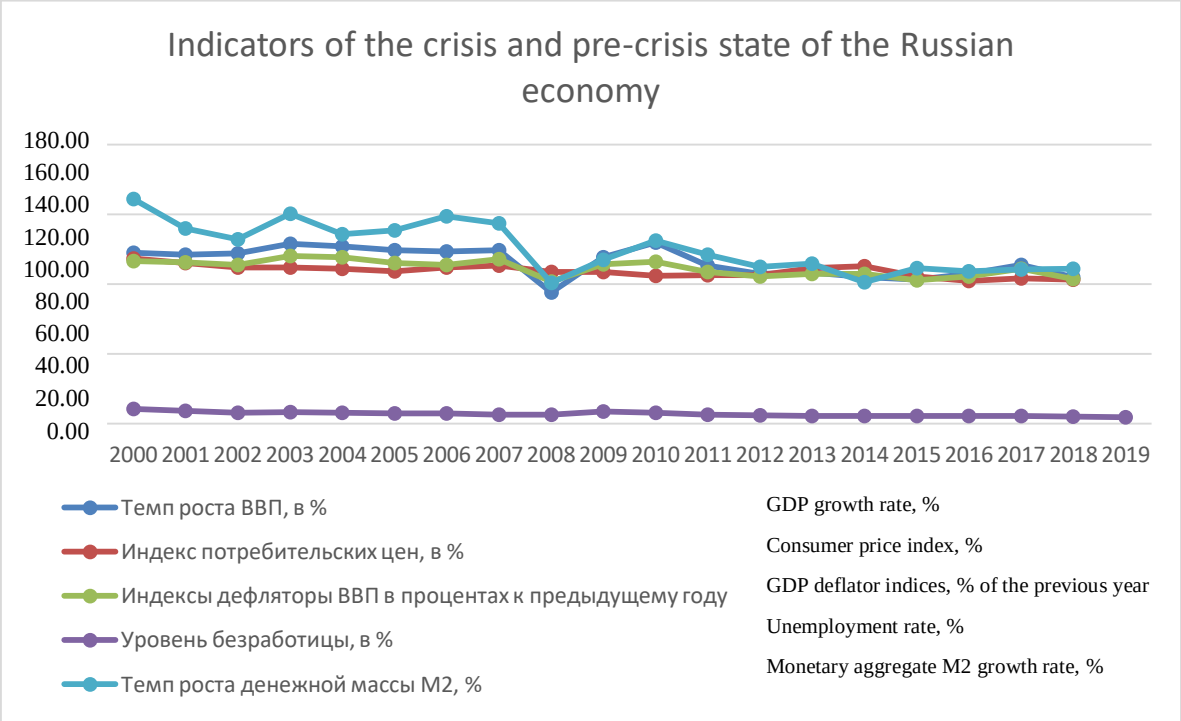
The trend of the monetary aggregate M2 in Russia from 2000 to 2019

The data in Table 11, namely the growth rate and the relative share of the monetary aggregate M2, also indicate the pre-crisis state a year before the crisis. Therefore, we will consider this indicator as an indicator of the economic crisis.

Thus, we have identified five indicators of the pre-crisis and crisis state of the economy. Therefore, according to our hypothesis, it turns out that five out of seven indicators are indicators of the crisis state of the economy. It should be noted that these indicators are relative values.

For clarity, Figure 1 presents five indicators out of six that confirmed the hypothesis that the GDP growth rate, deflator index, consumer price index, unemployment rate and the growth rate of the monetary aggregate are indicators of the crisis and pre-crisis state of the Russian economy.

[43] Finansy. Federal State Statistic Service. Retrieved from: https://rosstat.gov.ru/folder/11192



Source: compiled by authors

Figure 1

Indicators of the crisis and pre-crisis state of the Russian economy

All indicators selected for the analysis of the crisis state are relative indicators. Therefore, we propose to determine the index of the crisis state by the geometric mean. The order of the root will depend on the number of components, and since. in our case, we identified 5 indicators, then the order will be 5 (if more indicators are revealed, then the order of the root will change). The formula is as follows:

$$I_{crisis\ state} = \sqrt[5]{\left(\frac{\text{GDP GR}}{100\%}\right) * \left(\frac{\text{CPI}}{100\%}\right) * \left(\frac{\text{DI}}{100\%}\right) * \left(\frac{\text{UR}}{100\%}\right) * \left(\frac{\text{MA M2 GR}}{100\%}\right)}$$

Wherein:

GDP GR – GDP growth rate;

CPI – Consumer price index;

DI – Deflator index;

UR – Unemployment rate;

MA M2 GR – Monetary aggregate M2 growth rate.

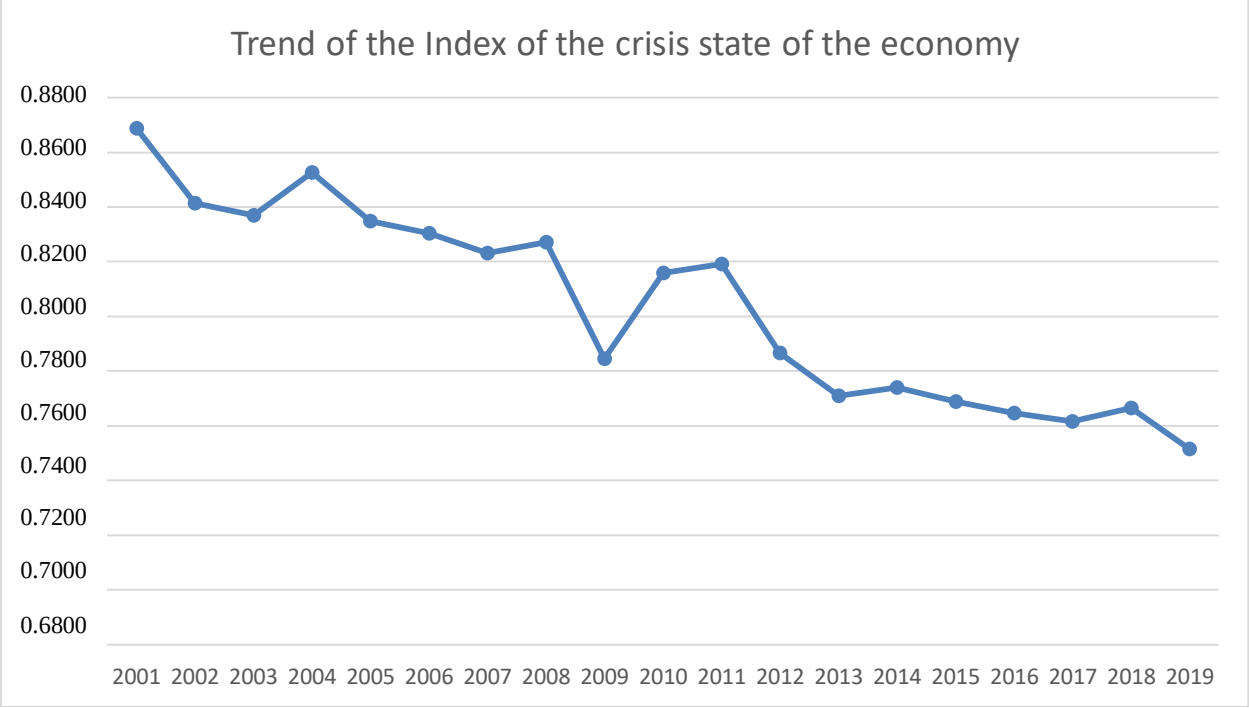
Let us calculate the crisis state index year by year, the calculation is presented in Table 12.

Year	Crisis state index
2001	0.8688
2002	0.8415
2003	0.8370
2004	0.8527
2005	0.8347
2006	0.8305
2007	0.8231
2008	0.8272
2009	0.7846
2010	0.8160
2011	0.8191
2012	0.7866
2013	0.7709
2014	0.7741
2015	0.7690
2016	0.7646
2017	0.7617
2018	0.7665
2019	0.7515

Source: compiled by authors

Table 12
Yearly crisis state index in Russia from 2000 to 2019

Let us examine the trend of the crisis state index of the Russian economy which is presented graphically (Figure 2).



Source: compiled by authors

Figure 2
The trend of the crisis state index of the Russian economy

Figure 2 clearly shows the trend before the crisis, this index tends to decrease, and after the adoption of crisis measures by the state, the index begins to grow.

To confirm our hypothesis, we also calculate the correlation between the index and its components using the Excel CORREL function. Table 13 shows the calculation of the correlation coefficient.

Correlation coefficient between the crisis state index and the GDP growth rate	Correlation coefficient between the crisis state index and the deflator index	Correlation coefficient between the crisis state index and consumer price index	Correlation coefficient between the crisis state index and the unemployment rate	Correlation coefficient between the crisis state index and the growth rate of the M2 monetary aggregate
0.758	0.840	0.752	0.894	0.907

Source: compiled by authors

Table 13

Correlation coefficient for components of the crisis state index

Thus, first of all, one can talk about a close connection between indicators and the crisis state index, and the closest connection is observed between the crisis state index and the monetary aggregate M2.

The analysis performed allows us to draw several conclusions.

Fundamental principles of economic theory are used to assess crises. Most authors consider the principles of assessment as a whole for the crisis management system in the context of the organization. What these principles have in common is:

- crises can be predicted;

- crises can be managed;

- the response to crises must be adequate;

- when entering a crisis, priority should be given to internal reserves.

In predicting crises, general forecasting principles are also used.

No source examines the mechanism of crisis management. Within this article, we discuss the process of building a general management mechanism. The emphasis is made on the possibility of using this mechanism in the framework of crisis management not only at the organizational level but also at the regional, national and global levels. We provide leading indicators of crises for each level.

All authors agree that the most common approaches to forecasting are mathematical modeling and a system of leading indicators. Moreover, the latter approach is a priority.

Within the framework of the calculation part, a mechanism for forecasting crises at the national level was applied (using the example of the Russian Federation).

For this, the following indicators were selected: GDP growth rates, changes in the GDP deflator, inflation growth rates, changes in real interest rates, trends of investments in equity, unemployment rate and the growth rate of the monetary aggregate M2.

Based on the results of the analysis, it was determined that the informative indicators of the pre-crisis and crisis state include the rate of GDP growth, changes in the GDP deflator, inflation growth rates, changes in real interest rates and the monetary aggregate M2.

Using these indicators, we have developed a crisis state index. Calculation of this indicator for 2001-2019 showed that before the crisis the index tends to decrease, and after the adoption of crisis measures by the state, the index begins to grow.

The calculation of the correlation between the index and its components also showed a close connection between them; the closest relationship is observed between the crisis state index and the monetary aggregate M2.

Thus, the study of the topic of economic crises and the transition of the economy to digital is very relevant among both Russian and foreign researchers and practitioners. Therefore, the process of constant updating and identifying new indicators that make it possible to predict the approach of crisis states of the economy is quite natural. An obvious advantage of the Risk index model that we proposed is its versatility which will allow combining diverse economic indicators.

Discussion

In the field of forecasting crises, the approaches based on mathematical modeling and a system of leading indicators are the most popular among scientists[44].

Within the article, we propose and test the original model for assessing and forecasting crises which contains leading indicators of crisis phenomena. The advantage of the model is its versatility, that is, the ability to use indicators of different levels of the economy depending on the objectives of the study.

As a result of the study, it was revealed that the assessment and forecasting of crisis phenomena are based on general principles of assessment and forecasting as well as the principles of crisis management in general. We formulated the features of digitalization that must be taken into account when supplementing the existing provisions of the crisis theory.

The article deals with one of the management mechanisms at the organizational level[45]. We substantiated the possibility of its application also for monitoring crisis phenomena not only at the enterprise level but also at the regional, national and global levels and offered an approximate list of indicators for each level.

Conclusion

There are a lot of forecasting methods that are quite universal and can be applied at all levels including forecasting crises.

[44] S. N. Grinyaev; A. N. Fomin; S. A. Kryukova y G. A. Makarenko, Metody prognozirovaniya srokov…
[45] B. N. Gerasimov, “Mekhanizm vzaimodeistviya elementov organizatsii...

However, there is no unified system of principles and mechanisms for assessing and forecasting crises for each of the management objects.

As a result of the study, we systematized the existing principles and mechanisms for assessing and predicting crisis phenomena and formulated the main distinctive parameters that should be taken into account when developing the theory of crises according to the concept of "Industry 4.0".

The proposed economic and mathematical model that contains crisis indicators allows one to combine diverse economic indicators.

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