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DIAGNOSING ECONOMIC SECURITY OF AN INDUSTRIAL ENTERPRISE

Economic crises, as a rule, have negarive effect on the potential of industrial enterprises: investments are reduced, fixed assets wear out, scientific-and-technological stock dwindles, the most qualified staff leaves, etc. These crises can be caused by both external and internal factors, the influence of which may become evident with a very long lag. In fact, the problems of holding economic security arise for every enterprise not only in times of crisis, but also when working in a steady economic environment. However, the anticrisis tasks to be solved vary significantly. Unfortunately, in practice, the executive board of a company begins thinking about the problems with the economic security only on the verge of bankruptcy when the company is «unable to settle with creditors» [1].

In the times of crisis, the most dangerous threat to the development of an enterprise is the destruction of its potential (industrial, technological, scientific-and-technical as well as staff), as the main factor of company viability. In this case, the ability to restore the enterprise potential using its own funds (depreciation and profits), as well as external borrowings is not provided. Both of these sources in a crisis situation are blocked.

At present, a large proportion of the national enterprises, working in an unstable economic environment, are unprofitable (Table 1), facing a deep decline in production and being in a critical condition.

Table 1

Part of the loss-making enterprises by industry, % [2]

Economic activities	2010	2011	2012	2013 (January-September)
Total	42,7	36,5	37,0	41,0
Industry	43,0	39,2	39,3	43,6
Construction	46,1	41,2	41,1	45,6
Wholesale and retail trade, repair of motor vehicles and motorcycles	39,7	35,4	36,0	35,4
Transportation, storage, postal and courier activities	47,2	38,6	39,9	46,9
Temporary facilities and catering services	43,6	40,7	42,6	44,9
Information and telecommunications	43,1	40,9	38,6	43,6
Financial and insurance activities	43,2	42,8	41,8	43,1
Real estate	51,2	46,9	45,7	48,5
Professional, scientific and technical activities	44,0	38,7	39,4	39,7
Education	37,1	33,0	32,9	35,9
Health care and social assistance	41,1	40,5	38,8	23,4
Arts, sports, entertainment and recreation	50,7	45,9	47,5	62,8

Thus, the task of the internal self-assessment and forecasting of their condition in terms of economic security, protection from the negative effects of internal and external origin which affect the capacity of the company, establishing a system of safety indicator monitoring, justification of threshold values and taking managerial decisions aimed at coutering threats is of current interest for industrial enterprises.

Considerable attention is paid by the national and foreign scientists to the problem of determining the probability of bankruptcy. Development of methodology and criteria for predicting bankruptcy was carried out by such leading scholars as E. Altman [3], W. Beaver [4], G. Sprinheyt [5], R. Wood, J. Taffler [6], R. Sayfullin, G. Kadykov [7], A. Tereshchenko [8], who have been developing discriminant models for evaluating the probability of bankruptcy.

These authors considered the possibility of building an adequate model of estimating the probability of bankruptcy of enterprises on the basis of the financial statements. Despite the fairly large number of publications [9, 10] about the management of financial resources of enterprises and about addressing issues of production and sales financing, current realities require more thorough investigation of non-financial factors impact on the economic security of the enterprise.

An important contribution to the solution of problems of crisis management was done by Ukrainian scientists A. Gradova [10], A. Chernyavsky [11], S. Shershneva [12] and others. However, foreign and national methods have certain shortcomings, and especially the inability to be used in the pre-crisis conditions. Moreover, in these works it is not considered that the various stages of the economic crisis are very different and need to have different anti-crisis management decisions.The relevance of this study is determined by the absence of the assessment which allows to determine the stage of the economic crisis and can be the basis for the development of anti-crisis strategy

The objective of the study is to develop the model of economic security'sdiagnostics, based on the analysis of not only financial but also other components of entities, the rationale of crisis management algorithm based on types of economic crisis.

Economic security of enterprise is defined as the state of the economic system that enables to keep resistance to external and internal threats, confront the factors of disorganization by using available potential. The system of economic security has traditionally included the following components: financial (effective use of financial resources), political and legal (compliance with applicable laws), intellectual and personnel (effective human resource management, preservation and development of staff), technical and technological (compatibility of the equipment and technologies with modern world analogues upon the condition of optimization of resource costs), informational (effective information and analytical support of economic activity), environmental (compliance with applicable environmental standards), powerful (physical security of employees). The general scheme of the factors of economic security of industrial enterprises is shown in Fig. 1.

For analytical assessment of each component, we should identify possible threats and evaluate the probability and consequences of their occurence. Gist of the study lies in carrying out such calculations, which, even in case of being incompletely adequate, would make it possible to obtain sufficiently reliable results you can rely on when choosing a commercial alternative [13]. Moreover, it should be emphasized that the mechanism for creating economic security should be based on internal system characteristics of the company, i.e. the socio-economic system itself should include «built-in» mechanisms to prevent internal and external threats, depending on the actual state of the economic system.

In the relation to the specifics of the company, the state of the economic security can be characterized as:

a) normal – indicators of economic security are within the threshold values, and the degree of usage of the available potential is close to technical standards;

b) pre-crisis – limitvalue of at least one of the indicators of economic security is exceeded, and the other indicators are close to the limit values, and the technical and technological capabilities to improve the conditions and results of production by taking precautionary measures are not lost;

c) crisis – limit values of most major indicators of economic security are exceeded, the signs of irreversible decline in production appear and a partial loss of capacity due to the depletion of technical resources occurs;

d) critical – all the boundaries separating normal and crisis state of production development are violated and the loss of part of the potential becomes imminent.
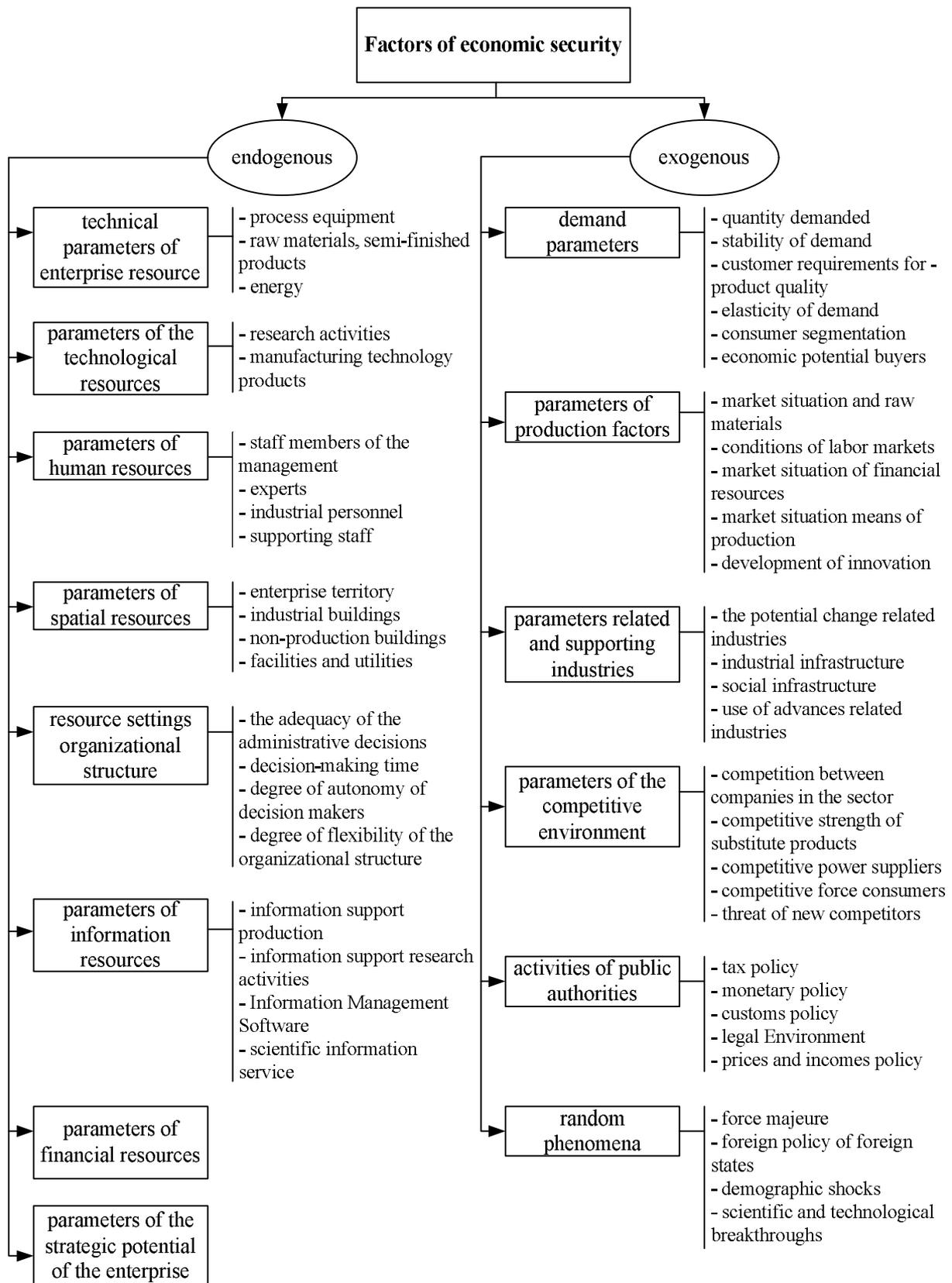
Fig. 1. Factors to ensure the economic security of industrial enterprises

During sustainable functioning, the company focuses on maintaining the normal rhythm of production and marketing, on the preventing physical and financial damage, on blocking up unauthorized access to official information, on the countering unfair competition and criminal manifestations.

Timely detection of adverse trends and prediction of bankruptcy are very important for national companies. However, there are no effective techniques which enable to make a reliable prediction of failure during the latent crisis. Various techniques for predicting bankruptcy which are used in domestic practice actually predict various types of crises [14]. Therefore, the assessments obtained by means of these techniques can often vary greatly and none of them can claim to be universal.

The choice of specific techniques should obviously be dictated by the peculiarities of the industry in which the company operates. Moreover, even the techniques themselves can and should be adapted as industry-specific.

There are two basic approaches to diagnosing bankruptcy. The first approach is based on financial data and includes the calculation of the coefficients: the Altman,Taffler discriminant models and others. The second one involves data analysis of bankrupt companies and their comparison with the company being studied.

The first approach has a rigorous mathematical justification, but enterprises that are in difficulty, in every way delay the publication of their reports, it common for companies in crisis to seek the whitewash of their activities. Furthermore, some financial indicators may testify the insolvency, while the other ones can notify stability or even a slight improvement. In such circumstances it is difficult to draw a conclusion about the real state of economic security.

The second approach is based on a comparison of signs of bankrupt companies with the characteristics similar to the analyzed company. But the problem is the lack of appropriate database in Ukraine.

Apart from the described above «quantitative» approaches to the prediction of bankruptcy, we can distinguish «qualitative» approach, which involves the analysis of some individual characteristics of the company in crisis, for example, excessive use of short-term borrowings as a source of financing long-term investments, a chronic shortage of current assets, adverse changes in the stock of orders, loss of key administrative staff, unscheduled stoppages or failures of production, conflicts in the company, etc. If a company has such characteristics, it is concluded that its economic security is at risk.

Thus, the choice of specific methods of analysis of economic security depends on the particular industry and the level company development. Moreover, even the methods themself may be adjusted taking into account the specificity of the company under analysis.

Methodology of estimation of economic security level should include a large number of procedures that should be combined into several successive stages:

1) determination of the components of economic security;

2) selection of specific indicators to measure the level of economic security;

3) selection of a basis for comparison ;

4) determining the direction and divisings pecific indicators into groups of raising and lowering economic security;

5) calculation of the values of general indicators in selected groups;

6) calculation of the values of economic security indicator;

7) determination of the degree of economic security;

8) determination of the dynamics of economic security and the nature of company development;

9) factor analysis of economic security and determination of prospects of an industrial enterprise development.

To build a model of analyzing economic security and detecting latent crisis, method of fuzzy sets can be used, which enables to introduce the linguistic variable, and to specify the relation of quantitative values of each factor with its qualitative linguistic description by the membership functions. Membership function is a quantitative measure of information uncertainty towards the analyzed parameters, the value of which is described in linguistically fuzzy form (e.g., «a very strong threat to economic security» - 5 points, «strong» - 4 «moderate» - 3, «weak» - 2, « very weak» - 1).

Information base for the analysis of economic security with the purpose of detecting the latent crisis is the accounting control and internal reporting. As the parameters can vary significantly for the characteristics of the economic security of enterprises in various industries, and even within the same industry, it is appropriate to evaluate indicators on the basis of dynamics of their bias over a certain period. For this purpose an index method is used, that is, each analyzed indicator is an index of changing of a certain indicator of activity or sustainability of the company; this is the ratio of the values of this index for the beginning and the end of the period. To assess the indices, the scale of values for each specific company is developed.

The linguistic variable is determined, depending on the degree of deviation of the actual figure of the index of economic security, proposed for a particular company. By each criterion of economic security the signal is assigned a numerical value about the threat of crisis ($C_i, i=1...n$, where n - number of indicators selected for analysis).

Further we introduce two intermediary indicators:

C – an integral indicator of the true signal conditions: $C = C + I$;

S – an integral component of the total force of signals about the loss of economic security: $S = S + C_i$.

To calculate the magnitude of the risk of a crisis for each group of indicators or for the whole enterprise, magnitude indicator of signal of economic security loss is used (M):

$$M = \frac{C}{n}100\%, \qquad (1)$$

where n – number of analyzed parameters for the group or for the whole company.

Magnitude of the economic security threat signals characterizes the crisis coverage and gives an idea of the number of areas affected by the crisis, that is, those areas where the loss of economic security is possible in the near future.

The intensity of the threat of losing economic security is suggested to calculate by the formula:

$$I = \frac{S}{n \cdot r}100\%, \qquad (2)$$

where I – intensity of signal of economic security loss;

r – dimension of scale of the signal values ($r = 5$).

The intensity of signals of economic security loss characterizes the depth of the crisis and gives an idea of the economic security of the industrial enterprise.

The size and intensity of threats to the economic security is estimated using the scale provided in Table 2.

Table 2

Linguistic evaluation scale and intensity of the threat of economic security

The numerical value of the index	Linguistic evaluation indicator	Forecast
< 10 %	extremely low	potential crisis
10 – 20 %	low	
20 – 40 %	average	latent crisis
40 – 70 %	high	
70 – 100 %	extremely high	

Values of above 40 % suggests the presence of latent crisis in the company and the loss of economic security. When the indicator values are less than 40 % the chance of having a crisis is low, the state is characterized as a potential crisis, which may be followed by the possible development of a latent crisis.

Assessment of the level of economic security must be made from the perspective of several components which characterize the availability and the results of using the individual elements of the economic potential of the company. Within each component of the overall level of economic security, we should highlight the elements which characterize the effectiveness of using certain types of company resources. Here is an example of indicators characterizing the financial, technical and technological components.

The financial component of economic security is assessed on the basis of these indicators:

equity ratio - reflects the level of financial stability;

cost ratio per one hryvnia sales - characterizes the efficiency of the production and management resources of the company;

return on sales - sales effectiveness;

absolute liquidity ratio - describes the solvency of the company.

Manufacturing component of economic security may be considered through the following indicators:

labour results - characterizes the efficiency of labor costs;

capital results - characterizes the efficiency of working capital;

assets ratio - describes the efficiency of fixed assets;

wear rate - reflects the state of the fixed assets of the enterprise;

the coefficient of the real property value - enables to estimate the total value of the company potential.

Similarly, we can estimate the other components of economic security.

Further we calculate generalizing indicators for each selected group; these indicators reflect the «strength» and «weakness» of the company from the perspective of economic security. Generalizing indicator values are calculated by formulas depending on the direction of the influence of the indicator on the economic security:

for increasing indices

$$K^{\uparrow}_{eb} = \frac{\sum_{i=1}^{n}\left(\frac{a_i^{\Pi} - a_{\min}}{a_{\min}} + \frac{a_{\max} - a_i^{H}}{a_{\max}}\right)}{n}, \quad (3)$$

where a_i^{Π}, a_i^{H} – the actual values of the partial indicators included in the group of indicators which increase the level of economic security ($i = 1,2, ... n$);

n – number of partial indicators in this group;

$a_{\min}$ – the minimum threshold value for a positive indicator;

$a_{\max}$ – maximum threshold value for negative indicator;

for decreasing indices

$$K^{\downarrow}_{eb} = \frac{\sum_{j=1}^{m}\left(\frac{a_{\min} - a_j^{\Pi}}{a_{\min}} + \frac{a_j^{H} - a_{\max}}{a_{\max}}\right)}{m}, \quad (4)$$

where a_j^{Π}, a_j^{H} – the actual values of the partial indicators which lower the level of economic security ($j = 1,2, ... m$);

m – number of partial indicators rates in the group.

In fact, the values of general indicators reflect the relative level of deviation of the values of selected parameters of theselected standards. Furthermore, the implementation of standardization enables to lay the indicators which are heterogeneous in economic nature for comparable form and combine them in generalizing terms.

Indicator of economic security (I_{eb}) should reflect the capabilities of the enterprise to maintain and improve the level of economic security, so it is calculated as the ratio of values of generalizing indicators:

$$I_{eb} = \frac{K^{\uparrow}_{eb}}{K^{\downarrow}_{eb}}. \quad (5)$$

In general, the value I_{eb} characterizes the state of the enterprise in terms of economic security at a given time, and therefore reflects the efficiency of using the economic potential of the company. Scale of assessment of economic security level and existence of crisis in the company is presented in Table 3.

Thus, the proposed method of determining the level of economic security of industrial enterprise is aimed at detecting the latent stage of the economic crisis.

Depending on the state of economic security and the type of crisis, specific set of anti-crisis measures is used. The general algorithm of maintaining economic security of the industrial enterprise, taking into account the stage of a crisis process and the difference strategic decisions and tactical measures at different stages of the crisis is presented in Fig. 2. The proposed algorithm consists of the following blocks: the block of reconizing the stages of the crisis process, the block of selecting the anti-crisis strategy

Characteristic values of the level of economic security

Value of the indicator of economic security	Characteristics of the level of economic security	Type of crisis
$I_{eb} > 1{,}25$	Security margin of the company	Potential crisis
$1 < I_{eb} < 1{,}25$	Sufficient level of enterprise security	
$I_{eb} = 1$	Equilibrium raising and lowering factors (stability)	Incipient crisis
$0{,}75 < I_{eb} < 1$	Allowable reduction in company security level	Developing crisis
$0{,}5 < I_{eb} < 0{,}75$	Maximum permissible reduction of security	
$0{,}25 < I_{eb} < 0{,}5$	Critical reduction of enterprise security	Progressive crisis
$0 < I_{eb} < 0{,}25$	Catastrophic reduction of enterprise security	

in accordance with the stage of the crisis, the block of developing corresponding anti-crisis measures and the block of evaluating the applied strategy.

Measures of meetingthe incipient crisis are similar to the activities of eliminating the potential crisis, that is the main emphasis should be directed towards the elimination of unfavorable factors, due to which a threat to economic security emerged. Developing crisis also carries a risk of transition into a heavy crisis. In this regard, the anti-crisis measures should concern the deeper foundations of economic security. Measures to eliminate the progressive crisis suggest a thorough review of enterprise strategy, as well as its mission and goals.

The enormity of crisis, i.e. the scope: the number of components of the crisis-ridden economic security, - is of great importance during the development of anti-crisis measures.

From the perspective of an enterprise strategy for a potential crisis a slight adjustment of company development course as well as eliminating the factors that influenced the emergence of adverse trends is enough, i.e. the anti-crisis measures are more tactical in nature. In case of the developing crisis it is necessary to develop measures to adjust development strategies, e.i. the measures aimed at normalizing the elements of economic security; there are strategic changes.

During the severe progressive crisis it is required to have the full use of the economic potential of the company, reviewing the company strategy, its mission, goals and objectives.

After choosing the appropriate anti-crisis strategy, the development of tactical measures to overcome the crisis should be started. Positive effect can be archieved only by using a tho-

roughly elaborated system of anti-crisis measures, presented in the form of a strategic project with its subsequent introduction in a strategic plan. Such plan is developed taking into account the characteristic features of the enterprise and the state of its economic security. Anti-crisis measures are formulated in form of specific tasks that are necessary at the moment. The main principles that should be followed while developing the anti-crisis measures are: feasibility, time and rationality limitations, the cost of solution should not exceed the resultant effect of their conducting.

Thus, the paper solves important scientific and practical tasks for the formation of the methodological approach for the level of economic security diagnosing. The main conclusions and recommendations are the following:

the key components of economic security of the industrial enterprise have been identified;

the classification of economic security states in accordance with the type of economic crisis has been proposed;

mathematical apparatus of assessing the level of economic security, which is based on the use of fuzzy set theory has been developed;

the algorithm of the anti-crisis management strategy selection, depending on the depth of the crisis and identifying the elements of economic security, has been proposed.

Management practices show that in a dynamic and uncertain environment an important role in the ensuring economic security and competitiveness of industrial enterprises is given to the effectiveness of anti-crisis management. The cyclical nature of the economy forces businesses to adapt to the changes in the internal and external environments in order to maintain economic security. But for the problem of

Block 1. Recognition process stages of crisis
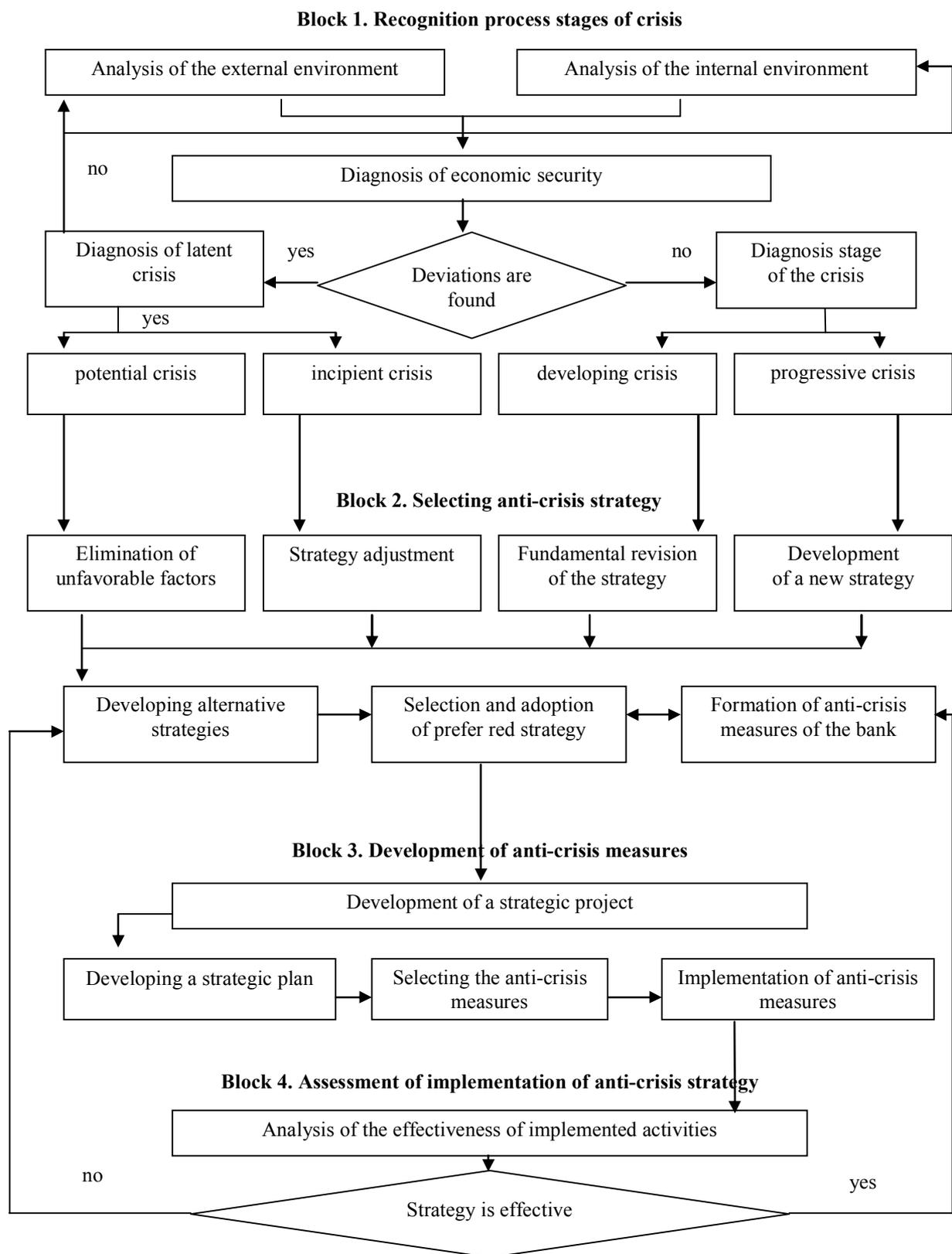
Fig. 2. The control algorithm of economic security

determining the economic security indicators of business enterprises, i.e. the index of economic security, there is still no universal solution. And the formation of economic-mathematical apparatus for making the scale of economic security indices for industrial enterprises is the subject to the author's further research.

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