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Середовище багатофакторного ризику в фінансовій системі підприємств агробізнесу

У статті розкрито теоретично-методологічні засади моделювання багатофакторного ризику в фінансовій системі підприємств агробізнесу під впливом макро- та мікрооточення. Обґрунтовано, що у фінансовій системі підприємств, з позиції оцінки класичної ймовірності випадкових багатофакторних подій, типові та повторювальні ситуації передбачають граничну кількість можливих фінансових результатів. Уточнено фактори випадковості за рахунок методів динамічного прогнозування, які витісняють статичні закономірності та прості екстраполяційні залежності. Доведено, що прогнозна екстраполяція дозволяє отримати лише частковий прогноз, відображаючи зміни окремих аспектів функціонування господарюючих об'єктів. При цьому, фінансові відносини між підприємствами представлені множиною зворотних фінансових зв'язків, які залежать від випадкового відхилення цілого ряду факторів, генеруючи у цьому процесі інформаційний потік щодо природи виникнення ризику. Виявлено, що для спрощення оцінювання багатофакторного ризику слід визначати не сам ризик, а невизначеність, з якої він походить – кредитна невизначеність, процентна невизначеність, маркетингова невизначеність, валютна невизначеність, інфляційна невизначеність, виробнича невизначеність. Доведено, що ризики при зміні зовнішнього макрооточення об'єднанні факторами, які демонструють відсутність системного зв'язку між державними програмами фінансування сільського господарства та підприємствами агробізнесу. Внутрішні ризики сформовані факторами мікрооточення, які забезпечують покриття витрат виробництва із обмежуючими параметрами формування зовнішніх джерел фінансування за рахунок власних фінансових ресурсів.

Ключові слова: фінансові ресурси, фінансова система, ризик, сільське господарство, підприємства агробізнесу, державні програми фінансування.

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Среда многофакторного риска в финансовой системе предприятий агробизнеса

В статье раскрыто теоретико-методологические основы моделирования многофакторного риска в финансовой системе предприятий агробизнеса под влиянием макро- и микроокружения. Обосновано, что в финансовой системе предприятий, с позиции оценки классической вероятности случайных многофакторных событий, типовые и повторяющиеся ситуации предусматривают предельное количество возможных финансовых результатов. Усовершенствовано факторы случайности за счет методов динамического прогнозирования, которые вытесняют статические закономерности и простые экстраполяционные зависимости. Доказано, что прогнозная экстраполяция позволяет получить лишь частичный прогноз, отражая изменения отдельных аспектов функционирования хозяйствующих объектов. При этом, финансовые отношения между предприятиями представлены множеством обратных финансовых связей, которые зависят от случайного отклонения целого ряда факторов, генерируя в этом процессе информационный поток о природе возникновения риска. Выявлено, что для упрощения оценки многофакторного риска следует определять не один риск, а неопределенность, с которой он происходит - кредитная неопределенность, процентная неопределенность, маркетинговая неопределенность, валютная неопределенность, инфляционная неопределенность, производственная неопределенность. Доказано, что риски при изменении внешнего макроокружения объединены факторами, которые демонстрируют отсутствие системной связи между государственными программами финансирования сельского хозяйства и предприятиями агробизнеса. Внутренние риски сформированы факторами микроокружения, которые обеспечивают покрытие издержек производства ограничивающих параметрами формирования внешних источников финансирования за счет собственных финансовых ресурсов.

Ключевые слова: финансовые ресурсы, финансовая система, риск, сельское хозяйство, предприятие агробизнеса, государственные программы финансирования.

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Environment of Multifactorial Risk in the Financial System of Agribusiness Enterprises

The article deals with the theoretical and methodological provisions of modeling the environment of multifactorial risk in the financial system of enterprises agribusiness under the influence of macro and micro projections. It is grounded that in the financial system of enterprises, from the standpoint of estimating the classical probability of random multifactorial events, typical and repeating situations provide the maximum amount of possible financial results. Accidental factors are improved due to dynamic forecasting methods, which supersede static regularities and simple extrapolation dependencies. It is proved that prognostic extrapolation allows only a partial forecast, reflecting the changes in certain aspects of the functioning of business objects. At the same time, financial relations between enterprises agribusiness are represented by a set of reciprocal financial ties, which depend on the random deviation of a number of factors, generating in this process an information flow about the nature of the occurrence of risk. It is grounded that in order to simplify the valuation of multifactorial risk, it is necessary to determine uncertainty from which it comes: credit uncertainty, interest uncertainty, market uncertainty, currency uncertainty, inflation uncertainty, and production uncertainty. It has been proved that the risks associated with the change in the external macro-profile are combined with factors that demonstrate the lack of a systemic link between the state agricultural financing programs and enterprises agribusiness. Internal risks are formed by factors of micro projection, which ensure the covering of production costs with the limiting parameters of the formation of external sources of funding at the expense of its own financial resources.

Keywords: *financial resources, financial system, risk, agriculture, enterprises agribusiness, government financing programs.*

Introduction. In the conditions of the formation of the new financial system, most of the subjects of economic activity revealed the inability to change systematically the development of future events in relation to financial activity. A deep understanding of risk as an element of financial relations management in agribusiness has an effective component-financial losses that endanger the financial system of agrarian enterprises with corresponding consequences for the economy. The most common positions associate risk with the possibility of danger or loss, lack of profits, the probability of occurrence of an adverse event, uncertainty of financial results, overcoming the uncertainty of situational choice of events. At the same time, the optimistic expectation is inherent in the very definition of the phenomenon of threat in the environment of probable risk, taking into account the possible positive result for covering financial expenses and limiting the parameters of the formation of financial resources.

Literature Review. The problem of risk is analyzed by many researchers of various spheres of human activity, but considerable attention in the modern methodology of risk assessment is disclosed in the writings of foreign authors, among which: P.J. Barry [16], E.F. Harrison [17], P. Drucker [18], L. Robinson [19]. The economic nature of the category «risk», the systematization of its manifestation, type structure and certain characteristics are widely considered in the scientific works of Ukrainian scientists – B.A. Rayzberg [11], V.V. Vitlinsky [3], V.M. Granaturov [4], O.I. Yastremsky [15] and others. At the same time,

despite the presence of quite a large number of publications on the above issues, further research will require the introduction of an optimal scientific approach to qualitative and quantitative evaluation of multifactorial risk in the financial system of enterprises agribusiness.

The purpose of the study is to consider the theoretical and methodological provisions the environment of multifactorial risk in the financial system of enterprises agribusiness under the influence of macro and micro projection.

Main Results. The high dynamism of market relations, constant generation in this process of new information determines the diversity and the random nature of the risk. Therefore, a wide range of definitions of the concept of «risk» is determined by the scale of the tasks, and can equally mark a local threat of a lack of profit in the near future, as well as a strategic assessment of the conditions of development of the enterprise. Therefore, from the standpoint of a universal definition, the most relevant is the interpretation of V.I. Dal, which simply implies «an action without a correct calculation» [5, p. 96]. As a result, the calculation of the onset of a risk event is very likely. It is evident that the task of neutralizing risk can be put into the rank of a scientific problem. Instead, the risk to be evaluated is a ground for justifying optimal managerial decisions.

High dynamic changes of causal relationships between factors and financial performance in the financial system of enterprises agribusiness complicate the use of formal methods of risk assessment based on the extrapolation of past and traditional methods of statistical

modeling. The process of making financial decisions leads to a situation of information that characterizes the respective risk parameters in determining the future of the financial system. So, V.V. Vitlinsky and L.I. Donets offer to interpret such situations using the probability theory apparatus adapted to risk assessment game models [3; 6]; G.I. Prosvetov uses cluster and dispersion analysis in addition to the probabilistic distribution and method of decision tree [10]; L.E. Basovskiy offers using machine simulation modeling systems except statistical evaluations and regression models [1].

From the standpoint of evaluating multifactorial events, classical probabilistic descriptions, except for concentration in typical and recurring situations, imply an unacceptable limit to the number of possible outcomes [9].

For example, we consider the possibility of using the most widespread method for assessing the risk situation based on the theory of games. We are talking about methods for determining the optimal behavior in the management of systems, which is characterized by the presence of a conflict situation. The formalization of the content description of the conflict is a mathematical model that includes two sides with opposing interests. The most common are games of two players; games of three or more participants are less explored due to difficulties in obtaining a decision.

The most common case of calculations involves a finite number of options for choosing solutions $C_1, ..., C_m$ (each variant corresponds to the result $r_i, i = 1, ..., m$), one has to find the variant with the highest value of the result – $\max r_i$. As r_i is accepted as profit, net income, profitability, another integral indicator of financial efficiency of management it is expedient to apply the criterion:

$$C_0 = \{C_{io} | C_{io} \in C \ \grave{U} \ r_{io} = \max_i r_i\}, \qquad (1)$$

The multiplicity of possible solutions is described by a matrix:

$$R = \left| r_{iy} \right|_{\substack{i=1,...,m \\ j=1,...,n}}, \qquad (2)$$

Next, in search of the most optimal solution, target functions are introduced according to the following criteria, for example:

1. Minimax criterion:
$$C_0 = \{C_{io} | C_{io} \in C \ \grave{U} \ r_{io} = \max_i \min_j r_{ij}\}, \quad (3);$$

2. Gambling:
$$C_0 = \{C_{io} | C_{io} \in C \ \grave{U} \ r_{io} = \max_i \min_j r_{ij}\}, \quad (4);$$

3. Sevige criterion:
$$C_0 = \{C_{io} | C_{io} \in C \ \grave{U} \ r_{io} = \min_i r_{io}\}, \qquad (5);$$

4. Neutral player criterion:
$$C_0 = \{C_{io} | C_{io} \in C \ \grave{U} \ r_{io} = \max_i \frac{1}{n} \sum_{j=1}^{n} r_{ij}\}, \quad (6)$$

and other criteria (Bayes-Laplace, Hodge-Lehman, Germier, etc. [20]).

However, the financial system of agribusiness enterprises is represented by a set of reciprocal financial ties in the aggregate of its elements, the behavior of which depends on the random deviation of a number of factors. Thus, the game as a simplified formalized model of the real situation can describe only the problem of business choice ($r_{io} = \min_j r_{ij}$, or $r_{io} = \max_j r_{ij}$, or $r_{io} = \min_i [\max_j (\max_i r_{ij} - r_{ij})]$, or $r_{ir} = \frac{1}{n} \sum_{j=1}^{n} r_{ij}$). In addition, the theory of games does not address the question of methods for assessing and measuring the value of alternatives. The consequence of this is the unreliability of most assumptions in describing the game, the presence of several principles of optimality in solving the same problem.

Figure 1 depicts a composition of methods for estimating the environment of multifactorial risk in the financial system of enterprises agribusiness.

In the tasks of assessing the risk situation, the Analytic Hierarchy Process [12] is also successfully used, which is a «systematic mathematical procedure for hierarchical representation of elements that determine the essence of a particular economic problem» [7, p. 280]. The hierarchy analysis method (MHA) is based on the principle of identity and includes the synthesis procedures for obtaining priority criteria and finding alternate solutions. The method differs by the possibility of representing a complex problem in the form of a tree of alternatives; prioritization by expert survey; calculation of priorities relative to an arbitrary top of a decomposition tree.

The main method of describing an area and its structure is the decision tree method. It is for normative forecasting, which allows considering any investigated system as a complex one that consists of individual interconnected elements and assess the relative importance of these elements. Based on the decision tree method, we will map the structure of the financial forecast. As a general goal (tree top) we accept the possibility of introducing risk forecast of the financial system of enterprises agribusiness of Steppe zone of Ukraine.

The second level of the decision tree of the system consists of functional subsystems, which are specified by the branching of the objectives of the third order (Fig. 2).
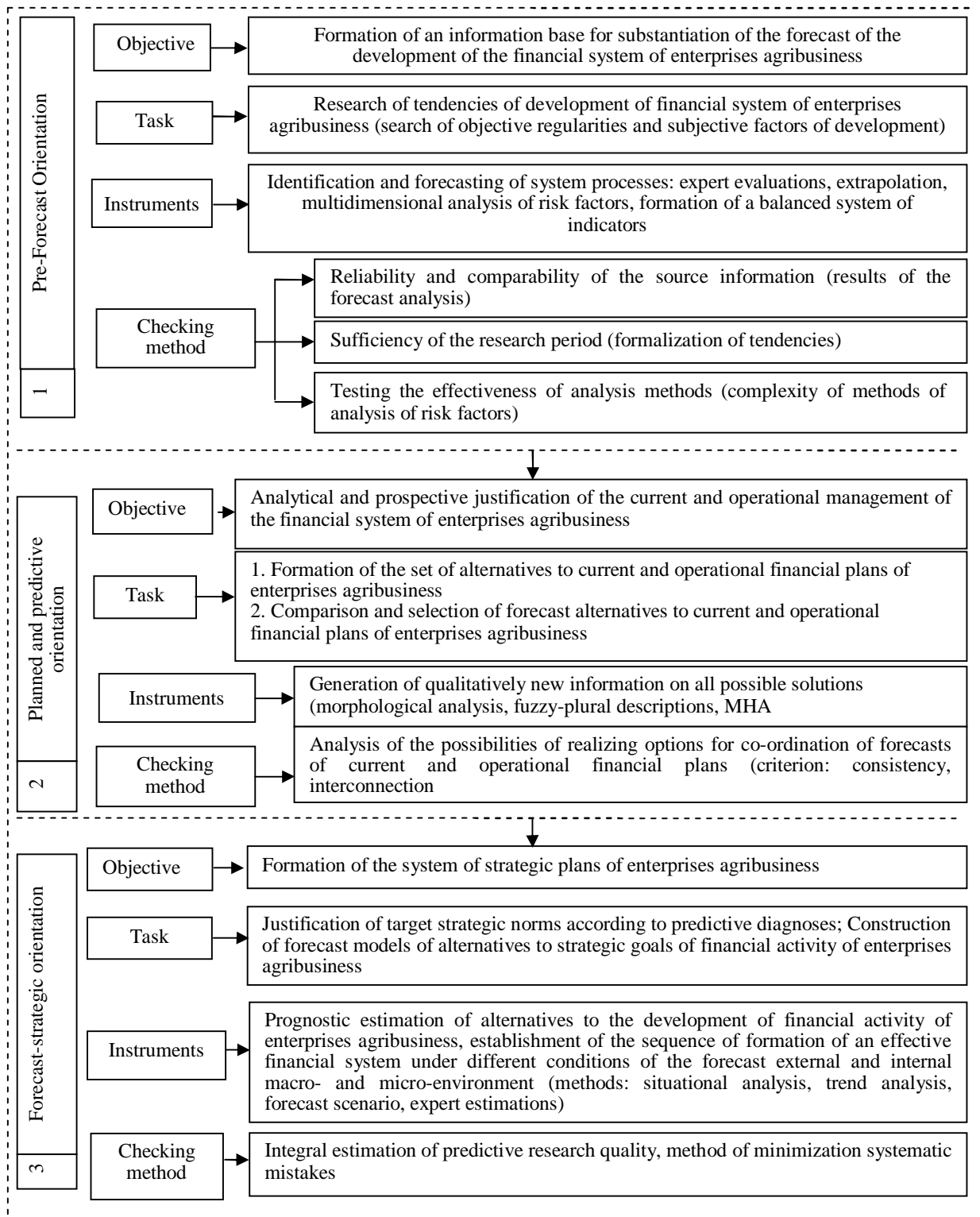
Pre-Forecast Orientation

Objective	Formation of an information base for substantiation of the forecast of the development of the financial system of enterprises agribusiness
Task	Research of tendencies of development of financial system of enterprises agribusiness (search of objective regularities and subjective factors of development)
Instruments	Identification and forecasting of system processes: expert evaluations, extrapolation, multidimensional analysis of risk factors, formation of a balanced system of indicators
Checking method	Reliability and comparability of the source information (results of the forecast analysis)
	Sufficiency of the research period (formalization of tendencies)
	Testing the effectiveness of analysis methods (complexity of methods of analysis of risk factors)

1

Planned and predictive orientation

Objective	Analytical and prospective justification of the current and operational management of the financial system of enterprises agribusiness
Task	1. Formation of the set of alternatives to current and operational financial plans of enterprises agribusiness 2. Comparison and selection of forecast alternatives to current and operational financial plans of enterprises agribusiness
Instruments	Generation of qualitatively new information on all possible solutions (morphological analysis, fuzzy-plural descriptions, MHA
Checking method	Analysis of the possibilities of realizing options for co-ordination of forecasts of current and operational financial plans (criterion: consistency, interconnection

2

Forecast-strategic orientation

Objective	Formation of the system of strategic plans of enterprises agribusiness
Task	Justification of target strategic norms according to predictive diagnoses; Construction of forecast models of alternatives to strategic goals of financial activity of enterprises agribusiness
Instruments	Prognostic estimation of alternatives to the development of financial activity of enterprises agribusiness, establishment of the sequence of formation of an effective financial system under different conditions of the forecast external and internal macro- and micro-environment (methods: situational analysis, trend analysis, forecast scenario, expert estimations)
Checking method	Integral estimation of predictive research quality, method of minimization systematic mistakes

3

Fig. 1. **Composition of methods for estimating the environment of multifactorial risk in the financial system of enterprises agribusiness**

Source: author's research.

The proposed area of the environment of forecasting risk of the financial system (FRFS) and its functional subsystems is based on the complexes of information, software, mathematical and technological support, which in its aggregate is the resource potential of the system. The physical structure of the forecasting background of the financial system risk is the result of the distribution of financial resources between the functional subsystems of the second and third levels. The third level determines the search for priorities of the FRFS or options for implementing the financial system: the study of the impact of external and internal risk factors (FR), the

study of financial opportunities for the implementation of decisions of enterprises agribusiness (FO) and scenario design of financial decisions (SD). The calculation of priorities in the allocation of financial resources is to assess the forecast capabilities of the functional subsystems PFA, AFS, OFA, CFD, CFP, AFD, RFA

(Tab. 1) and options for the implementation of the financial system (FR, FO, SD) (Tab. 2). Thus, the priorities of the FR, FO and SD relative to all functional subsystems of the second level (PFA, AFS, OFA, CFD, CFP, AFD, RFA) come from matrices of pairwise comparison with respect to these goals.
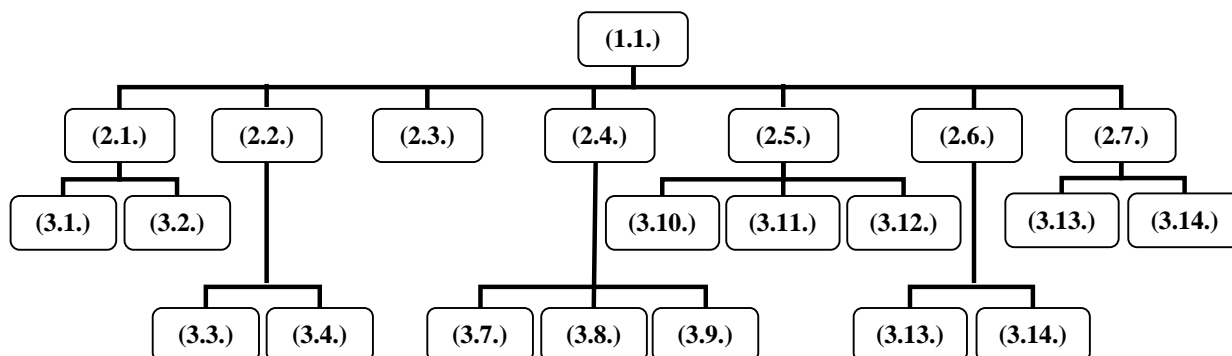
(1.1.) – the environment of forecasting risk of the financial system (FRFS); (2.1.-2.7) – functional subsystems: (2.1.) – «Planning of the financial activities» (PFA); (2.2) – «Analysis of the state of financial system» (AFS); (2.3.) – «Organization of the financial activity» (OFA); (2.4.) – «Control over execution of the financial decisions» (CFD); (2.5.) – «Coordination of the financial programs» (CFP); (2.6.) – «Accounting for results of execution of the financial decisions» (AFD); (2.7.) – «Regulation of the financial activity» (RFA); (3.1) – Monitoring of the main financial indicators in order to ensure that the results are consistent with the strategic goals of the enterprise; (3.2) – compilation and development of operational and current financial plans; (3.3) – Analysis of the current financial situation with the purpose of forecasting the results of activity of enterprises agribusiness and substantiating the financial strategy; (3.4.) – Analysis and assessment of the environment of enterprises agribusiness; quantitative assessment of risk factors; (3.5) – Attraction of financial resources and implementation of financing schemes providing the minimum cost of advanced capital; (3.6.) – Informational and methodical provision of financial planning and forecasting at enterprises; (3.7) – Coordination and implementation of financial control over current activities in accordance with the financial strategy; (3.8) – Control of deviations of actual indicators from the financial plan indicators and the statement of the reasons; (3.9) – Control over observance of the requirements of the legislation and fulfillment of legal obligations; (3.10) – Development of projects of the strategy of financial activity of enterprises agribusiness; (3.11.) – Coordination of strategic and tactical financial plans of enterprises agribusiness; (3.12.) – Information support for monitoring the implementation of the financial strategy of enterprises agribusiness; (3.13.) – Accounting the factors of the rejection of projected financial parameters from the target; (3.14) – Providing an integrated system of reports that objectively reflects the results of enterprises agribusiness; (3.15.) – Possible scenarios for the future development of financial activity of enterprises agribusiness; (3.16) – Correction, linking the current and operational financial plans according to the financial strategy of enterprises agribusiness.

Fig. 2. **The area of the environment of forecasting risk of the financial system of enterprises agribusiness**
Source: author's research.

Distribution of financial resources in the environment of forecasting risk of the financial system (pairwise comparison in the functional subsystems of the second level)

	The inverse-symmetric matrix of the horizontal pairwise comparison							I max	Index of the Coherence (IC)	Column of Priorities
FRFS	**PFA**	**AFS**	**OFA**	**CFD**	**CFP**	**AFD**	**RFA**			$\begin{pmatrix} 0.24 \\ 0.20 \\ 0.17 \\ 0.15 \\ 0.10 \\ 0.09 \\ 0.05 \end{pmatrix}$
PFA	1	2	2	2	3	3	3			
AFS	1/2	1	2	3	2	2	3			
OFA	1/2	1/2	1	2	3	2	3	7,536	0,089	
CFD	1/2	1/3	1/2	1	3	2	3			
CFP	1/3	1/2	1/3	1/3	1	2	2			
AFD	1/3	1/2	1/2	1/2	1/2	1	3			
RFA	1/3	1/3	1/3	1/3	1/2	1/3	1			

Source: author's own calculations.

The system of estimates in the matrix is based on the calculation of the importance of each functional subsystem and the predictive properties of their elements (Fig. 2). The calculations performed (calculating the own column and matrix Index of the Coherence) indicate that the inverse-symmetric matrix isconsistent (I_{max} ³ n, IC £ $0,1$), and the priority column shows the distribution of financial resources across all functional subsystems. Accordingly, the comparison of the forecast financial possibilities of all functional subsystems, «Planning of the financial activities» receives a resource priority of 0.24, «Analysis of the state of financial system» – 0.20, «Organization of the financial activity» – 0.17, «Control over execution of the financial decisions» – 0.15, «Coordination of the financial programs» – 0.10, «Accounting for results of execution of the financial decisions» – 0.09, «Regulation of the financial activity» – 0.05. The distribution of priorities leads to a high degree

of importance of planning and forecasting, analytical and prospective calculations of the risk of the financial system of enterprises agribusiness. It is important that under the conditions of parallel processes in the FRFS (horizontal and vertical links), these functional subsystems are responsible for solving the application problem. After all, it is the planning and risk analysis of the financial state of the enterprise that forms the main information base of the process of making management decisions.

Then we have evaluated the priorities of the distribution of financial resources according to the version of the implementation of the financial system in each functional subsystem. Corresponding matrices of pairwise comparison, indexes of consistency and priority columns are given in Tab. 2. The system of estimates in matrices is based on the calculation of the importance of a particular functional subsystem.

Table 2

Distribution of financial resources in the environment of forecasting risk of the financial system of enterprises agribusiness (pairwise comparison in the functional subsystems of the second and third levels)

	Return-symmetric matrices of vertical pairwise comparison			I_{max}	Index of the Coherence (IC)	Column of Priorities
PFA	FR	FO	SD	3,056	0,028	$\begin{pmatrix} 0.60 \\ 0.30 \\ 0.10 \end{pmatrix}$
FR	1	3	5			
FO	1/3	1	3			
SD	1/5	1/3	1			
AFS	FR	FO	SD	3,111	0,056	$\begin{pmatrix} 0.59 \\ 0.33 \\ 0.08 \end{pmatrix}$
FR	1	3	7			
FO	1/3	1	5			
SD	1/7	1/5	1			
OFA	FR	FO	SD	3,005	0,002	$\begin{pmatrix} 0.64 \\ 0.24 \\ 0.12 \end{pmatrix}$
FR	1	3	5			
FO	1/3	1	2			
SD	1/5	1/2	1			
CFD	FR	FO	SD	3,006	0,003	$\begin{pmatrix} 0.57 \\ 0.32 \\ 0.11 \end{pmatrix}$
FR	1	2	5			
FO	1/2	1	3			
SD	1/5	1/3	1			
CFP	FR	FO	SD	3,164	0,082	$\begin{pmatrix} 0.48 \\ 0.45 \\ 0.07 \end{pmatrix}$
FR	1	2	5			
FO	1/2	1	7			
SD	1/5	1/7	1			
AFR	FR	FO	SD	3,025	0,012	$\begin{pmatrix} 0.56 \\ 0.36 \\ 0.08 \end{pmatrix}$
FR	1	2	7			
FO	1/2	1	5			
SD	1/7	1/5	1			
RFA	FR	FO	SD	3,011	0,005	$\begin{pmatrix} 0.53 \\ 0.31 \\ 0.16 \end{pmatrix}$
FR	1	2	3			
FO	1/2	1	2			
SD	1/3	1/2	1			

Source: author's own calculations.

Thus, in the functional subsystem of «Planning of the financial activities», the option «study of the impact of external and internal risk factors» has a significant advantage over «scenario design of financial decisions» (5) and a slight advantage over «the study of financial opportunities for the implementation of decisions of enterprises agribusiness» (3). This means that the analysis of the impact on the planning of the financial activities of enterprises agribusiness of risk factors should stipulate and set the initial parameters (limits) for financial planning procedures. In turn, the «the study of financial opportunities for the implementation of decisions of enterprises agribusiness» has a certain advantage over scenario design of financial decisions (3) in planning. In the functional subsystem of the «Analysis of the state of financial system» the option «financial opportunities» also receives a significant advantage over «scenario design» (5); the high significance of the analysis of the influence of risk factors has been demonstrated. Thus, the implementation of the financial system is due to the relationship between the analysis her is state and the analysis of the impact of risk factors.

For column priorities in this functional subsystem the direction of «study the impact of external and internal risk factors» is provided by 59 % of the projected background of the financial system. Other options are estimated as 33 % and 8 % of the financial resources. In the block of «Organization of the financial activity» the account of risk factors due to priority of 0.64, is particularly important in providing information and methodical planning and forecasting procedures in implementing FRFS. In functional subsystem of «Control over execution of the financial decisions» when drawing up the matrix of pairwise comparison the high importance of the «study of financial opportunities for the implementation of decisions of enterprises agribusiness» was marked that governs the financial control for the main activity under the financial strategy and the reasons for deviations of actual indicators of performance and indicators of financial plan.

According to column of priorities of calculated matrix the present variant of embodiment FRFS received priority of 0.32. The result of comparison in the functional subsystem of «Coordination of the financial programs» of such areas of the FRFS as the «research of the impact of risk factors» and «study of financial opportunities» was the same priority in the distribution of financial resources: 48 % and 45 % respectively. The option of «scenario design of financial decisions» requires a balance of 7 %, but it is responsible for implementing the draft strategies of financial activities of enterprises agribusiness. In the functional subsystem of «Accounting for results of execution of the financial decisions» the principle of distribution of financial resources is similar to the previous versions. Nevertheless, it is worthwhile to dwell on such an option of the FRFS as the «scenario design of financial decisions», which in its functional subsystem of «Regulation of the financial activity» received its highest priority of 0.16. And this is possible, because the main function of this subsystem is the generation of scenarios for the future development of financial activities of enterprises agribusiness.

Then it is easy to find the column of the third level priorities, for which we multiply the columns of priorities for vertical and horizontal pairwise comparison:

$$\begin{pmatrix} 0.60 & 0.59 & 0.64 & 0.57 & 0.48 & 0.56 & 0.53 \\ 0.30 & 0.33 & 0.24 & 0.32 & 0.45 & 0.36 & 0.31 \\ 0.10 & 0.08 & 0.12 & 0.11 & 0.07 & 0.08 & 0.16 \end{pmatrix} \begin{pmatrix} 0.24 \\ 0.20 \\ 0.17 \\ 0.15 \\ 0.10 \\ 0.09 \\ 0.05 \end{pmatrix} = \begin{pmatrix} \mathbf{0.58} \\ \mathbf{0.32} \\ \mathbf{0.10} \end{pmatrix}$$

Thus, according to the calculations, for the decision of the third order it is necessary to allocate financial resources on: the study of the impact of external and internal risk factors – 58 %, the study of financial opportunities for the implementation of decisions of enterprises agribusiness – 32 % and scenario design of financial decisions – 10 %. We should note that most of the financial resources are aimed at eliminating the risk, which methodologically reflects the probabilistic nature of forecasting procedures.

In the functional subsystem the planning of the financial activities of enterprises agribusiness, the study of the impact of external and internal risk factors is carried out using classical probabilistic and fuzzy-plural descriptions, for example, in calculating changes in the structure of future costs (risk - unpredictable costs), income for the future period (risk – lower income), calculations of cash requirements (risk – insolvency). The calculation of the effective use of financial resources in the plane of random factors (market risk, production risk, credit risk, etc.) is also carried out. In the functional subsystem of the analysis of the financial state of enterprises agribusiness, this direction is realized by comparing the data of the general and structural assessment of the financial state with the data of the conducted analysis of external and national factors of influence, for example, such factors as inflation, level of competition, branch affiliation or other order – level of specialization, technical equipment, relations of the enterprise with financial institutions.

In the subsystem of the organization of the financial activity of enterprises agribusiness, the analysis of risk factors adjusts the schemes of external financing activities. Another component of «Informational and methodical provision of financial planning and forecasting at enterprises» requires constant quantitative consideration of related factors (risk) and subsequent correction of the information management process of the enterprise. In the process of «Control over execution of the financial decisions», all operations in the problem

area are generated by models of feedback between risk and changes in the financial strategy of enterprises agribusiness; between the reasons of deviations of actual indicators and financial plan indicators, etc.

The environment of forecasting risk of the financial system in the «Coordination of the financial programs» subsystem is realized in the organizational and managerial concept of the formation and use of reliable information, for example, on preserving the balance between the processes of tracking changes in the external and internal environment of enterprises agribusiness and monitoring the implementation of their financial strategy. In the subsystem of «Accounting for results of execution of the financial decisions», related factors are identified

and distributed in an integrated system of reports that objectively and fully reflect the performance of enterprises. In the functional subsystem of «Regulation of the financial activity» all information procedures concerning the influence of external and internal risk factors are directed to the generation of scenarios for the future development of financial activity of the enterprise. Partial solutions are consistent with the introduction of regulatory measures on the interconnection of current and operational financial plans according to the financial strategy of enterprises agribusiness. Figure 3 presents the formed environment of projected risk of the financial system of enterprises agribusiness.
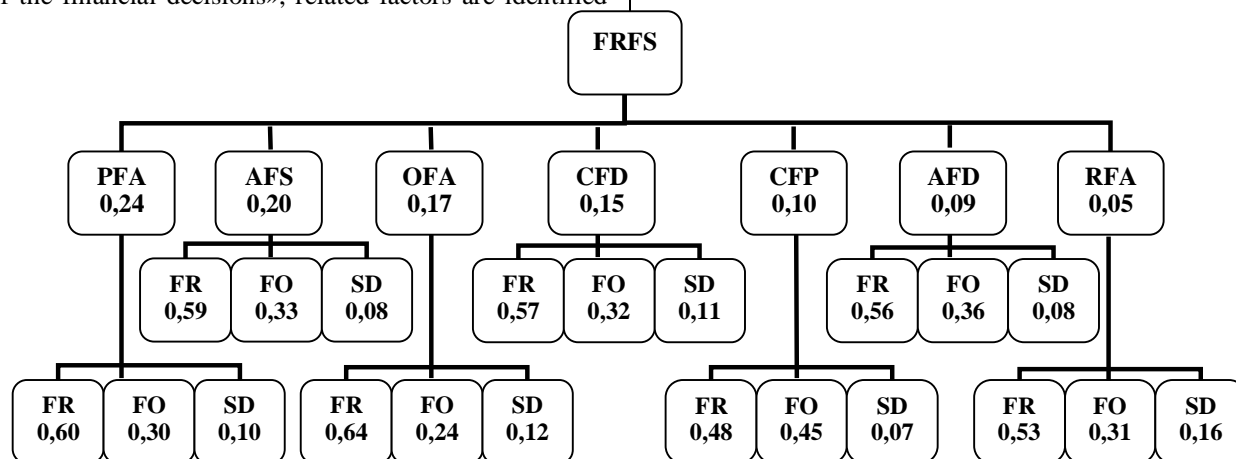

Figure 3. **The formed environment of projected risk of the financial system of enterprises agribusiness**
Source: author's own calculations.

The representation of all elements in the form of functional relations and their weight characteristics is demonstrated by the dynamic distribution of financial resources in the environment of forecasting risk of the financial system (FR, FO, SD) with respect to subsystems of the second order (PFA, AFS, OFA, CFD, CFP, AFR, RFA), which in fact represents the activation of effective financial management of enterprises agribusiness and their adaptation to European integration processes with high dynamics of changing the external and internal environment. In addition, the content of the methods for environment of risk in the financial system is gradually adapting to the international standards system. Therefore, the main purpose of the developed system is to use the complex mathematical apparatus of information analysis, in the form of application of software packages for systematic monitoring and timely response to changes in the current activity of enterprises, forecasting the prospects for their development based on a complex of modeling multifactorial risk in the financial system at a distribution of the financial resources of enterprises.

We believe that in order to simplify the valuation of multifactorial risk in the financial system, it is necessary to determine uncertainty from which it comes: credit uncertainty, interest uncertainty, market uncertainty, currency uncertainty, inflation uncertainty, and production uncertainty. Attempts to reduce the uncertainty of a large number of variables in assessing the parameters of the financial system can achieve a

sufficiently high degree of specification of risk, in particular, to determine its boundaries through the scale of financial activity of enterprises agribusiness.

Methodology of assessment of multifactorial risk is based on the initial value-financial losses which are presented as a function of a combination of factors that affect prognosis indicator parameters through the financial system. With expert research variable risk factors are generated and a new database is formed to assess the overall value of variables. The logic of forming a coherent system of macro and microeconomic assessment is embodied in the results of this research, which is environment of multifactorial risky in the financial system by quality criteria of enterprises agribusiness expert assessments that are based on the method of multivariate smooth, harmonic instruments of Theil-Veyge and Holt-Winters.

In order to determine the set of variants of the system combination, a discriminant function is introduced:

$$I_1 = f_1 Y_1 + ... + f_k Y_k, \qquad (7)$$

Each combination group was evaluated in two ways, the first one showed affiliation $Y_k [I_i(a_i, b_i, c_i, d_i)]$ to $Q_n \hat{I} A$, and the other $Y_k [I_i(a_i, b_i, c_i, d_i)]$ to $R_n \hat{I} B$. The first method was evaluated on the total cumulative interest, that is, which total percentage is given by the factors of the variables, and the second method shows the distribution of the coefficient

of consistency of the answers of experts ($K_{узг} = 1 - \eta$) calculated on the basis of the coefficient of qualitative variation η:

$$\eta_i = \frac{k}{k-1} \times \frac{(\sum_j f_{ij})^2 - \sum_j f_{ij}^2}{(\sum_j f_{ij})^2}, i = \overline{1, m}; j = \overline{1, N}, \quad (8)$$

where, k – number of places occupied by *i-a* sign; f_{ij} – number of experts who assigned *j-th* place to the *i-th* criterion; *m* – number of ranked attributes; *N* – number of interviewed experts.

Variants of evaluation of multifactorial risky in the financial system of enterprises agribusiness are carried out on the basis of the results of expert evaluation on the criterion of similarity, the risk zone, coefficient of coherence, origin of influence, cross-activation of basic and superstructural factors. Interpretations of the position of specialists of the investigated enterprises were preceded by the estimation of their relative homogeneity by the *k-medium* method, designed to distribute observation to a given number *k(k<n)*. The concept of homogeneity is formed by the distribution of the type of observation:

$$Q(S) = \sum_{j=1}^{k} \sum_{X_i \in S(j)} d^2(X_i; \overline{X}(j)), \quad (9)$$

where, $S = (S^{(1)}, S^{(2)}, ..., S^{(k)})$ it defines the distribution of observations $X_1, X_2, ... X_n$ on *k-classes*; $\overline{X}(j) = \frac{1}{n_j} \sum_{X_i \in S(j)} X_i$ – this is the destination center of the *j*-class; n_j – the number of elements in *j*-class; $d^2(X_i; \overline{X}(j))$ – is the square of the Euclidean distance X_i from the observation to the destination center $\overline{X}(j)$.

Thus, (9) will correspond to the average level of intra-group observation of distribution, which characterizes S. The procedure for distributing the type of observation includes several stages of multidimensional smoothing of data. Using the software «Data Mining», the final distribution S of the studied set of observations for *k-classes* is carried out in accordance with the rule of minimum distance with respect to the destination centers $X = X^{(n-k)}$ (observation X_i belongs to the class *j0* if $d(X_i; \overline{X}(j_0)) = \min_{1 \leq j \leq k} d(X_i, \overline{X}(j))$.

The studied agribusiness enterprises, based on the indicators of the state of financial system (its signals), were divided into four groups (Tab. 3).

Table 3

Distribution of enterprises agribusiness according to the indicators of the state of financial system

Group of enterprises with equal level of risk (1)	Group of enterprises with a stable level of risk (2)
$x_1^-, x_2^-, x_3^-, x_4^-, x_5^-, x_6^-, x_7^-, x_8^-,$ $x_9^-, x_{10}^-, x_{11}^-, x_{12}^-, x_{13}^-, x_{14}^-, x_{15}^-, x_{16}^-$	$x_1^-, x_2^-, x_3^-, x_4^-, x_5^-, x_6^-, x_7^-, x_8^-,$ $x_9^-, x_{10}^-, x_{11}^-, x_{12}^-, x_{13}^-, x_{14}^-, x_{15}^-, x_{16}^-$
Group of enterprises with a shaky risk (3)	Group of enterprises with high risk (4)
$x_1^-, x_2^-, x_3^-, x_4^-, x_5^-, x_6^-, x_7^-, x_8^-,$ $x_9^-, x_{10}^-, x_{11}^-, x_{12}^-, x_{13}^-, x_{14}^-, x_{15}^-, x_{16}^-$	$x_1^-, x_2^-, x_3^-, x_4^-, x_5^-, x_6^-, x_7^-, x_8^-,$ $x_9^-, x_{10}^-, x_{11}^-, x_{12}^-, x_{13}^-, x_{14}^-, x_{15}^-, x_{16}^-$

Source: author's research.

The first group (cluster 2) included six companies with an equal level of risk and the best signals of the financial system. These are enterprises with significant investment potential, high profitability and other indicators with positive growth dynamics during 2015-2016. The second group formed a cluster 4, which has six stable companies. The indicators of the state of financial system of enterprises agribusiness show relatively acceptable dynamics of financial development, but unbalanced production activities for two years. Signals of the financial system on cost recovery, lack of reserve capital indicate a threat of loss of financial stability in the event of the emergence of risk factors of financing.

Cluster 3, which brings together ten companies and characterizes the decline in the stability of their financial development, forms a vulnerable group.

In addition, these enterprises with existing production facilities have a high degree of concentration of attracted financial resources, including the share of long-term loans. In the context of the financial crisis, these signals correspond to the unstable state of solvency of agribusiness enterprises, due to the high sensitivity to the influence of external macro- and micro-exposures. However, for the relative profitability of enterprises there is an opportunity to cover operating expenses.

The last group (cluster 1) (a high risk or lost stability) has three enterprises which activities are characterized by significantly weakened indicators of the state of financial system (indicators below the limit or regulatory, which tend to decline over two years), the high degree of wear of the main means and operating profitability. This grouping provided the search for causes of destabilization of the financial system in the investigated enterprises. The study of the influence of each risk factor relative to the level of the state of financial system of a certain group of enterprises is presented in Tab. 4.

Table 4

Estimation of variants of multifactorial risk in the financial system of enterprises agribusiness

The risk zone	Activation, system solution	Expert assessments			Investigated enterprises		
		Criteria of similarities	*Cum.* %	$C_{coherence}$	Criteria of similarities	*Cu*m. %	Average value
Exterior macroenvironment	BF1× SF1 $I_1a_1\hat{I} R_1\hat{I} B$	$Y_1^1(I_1a_1)$	18.2	0.44	$Y_1^1(I_1a_1)$	15.9	0.28
		$Y_2^1(I_1a_1)$	28.4	0.38	$Y_2^1(I_1a_1)$	28.6	0.25
	BF1× SF2 $I_2b_1\hat{I} R_1\hat{I} B$	$Y_1^1(I_2b_1)$	16.4	0.38	$Y_1^1(I_2b_1)$	15,1	0.33
		$Y_2^1(I_2b_1)$	18.6	0.35	$Y_2^1(I_2b_1)$	22.6	0.32
	BF1×SF3 $I_3c_1\hat{I} R_1\hat{I} B$	$Y_1^1(I_3c_1)$	14.5	0.48	$Y_1^1(I_3c_1)$	20.9	0.35
		$Y_2^1(I_3c_1)$	24.7	0.38	$Y_2^1(I_3c_1)$	33.5	0.33
	BF1× SF4 $I_4d_1\hat{I} R_1\hat{I} B$	$Y_1^1(I_4d_1)$	20.8	0.39	$Y_1^1(I_4d_1)$	19.7	0.33
		$Y_2^1(I_4d_1)$	30.9	0.28	$Y_2^1(I_4d_1)$	25.8	0.30
The inner environment	BF2× SF1 $I_1a_2\hat{I} R_2\hat{I} B$	$Y_1^2(I_1a_2)$	17.4	0.36	$Y_1^2(I_1a_2)$	11.8	0.29
		$Y_2^2(I_1a_2)$	27.9	0.33	$Y_2^2(I_1a_2)$	17.2	0.27
	BF2× SF2 $I_2b_2\hat{I} R_2\hat{I} B$	$Y_1^2(I_2b_2)$	14.8	0.42	$Y_1^2(I_2b_2)$	24.6	0.28
		$Y_2^2(I_2b_2)$	26.9	0.33	$Y_2^2(I_2b_2)$	35.8	0.26
	BF2× SF3 $I_3c_2\hat{I} R_2\hat{I} B$	$Y_1^2(I_3c_2)$	18.3	0.31	$Y_1^2(I_3c_2)$	14.1	0.28
		$Y_2^2(I_3c_2)$	28.2	0.38	$Y_2^2(I_3c_2)$	23.8	0.28
	BF2× SF4 $I_4d_2\hat{I} R_2\hat{I} B$	$Y_1^2(I_4d_2)$	19.6	0.42	$Y_1^2(I_4d_2)$	16.1	0.36
		$Y_2^2(I_4d_2)$	30.7	0.39	$Y_2^2(I_4d_2)$	29.5	0.34
External microenvironment	BF3× SF1 $I_1a_3\hat{I} R_3\hat{I} B$	$Y_1^3(I_1a_3)$	18.9	0.38	$Y_1^3(I_1a_3)$	13.7	0.30
		$Y_2^3(I_1a_3)$	26.1	0.31	$Y_2^3(I_1a_3)$	21.9	0.29
	BF3× SF2 $I_2b_3\hat{I} R_3\hat{I} B$	$Y_1^3(I_2b_3)$	22.3	0.37	$Y_1^3(I_2b_3)$	18.8	0.35
		$Y_2^3(I_2b_3)$	34.9	0.45	$Y_2^3(I_2b_3)$	31.1	0.32
	BF3× SF3 $I_3c_3\hat{I} R_3\hat{I} B$	$Y_1^3(I_3c_3)$	15.2	0.38	$Y_1^3(I_3c_3)$	16.1	0.39
		$Y_2^3(I_3c_3)$	20.9	0.35	$Y_2^3(I_3c_3)$	28.2	0.25
	BF3× SF4 $I_4d_3\hat{I} R_3\hat{I} B$	$Y_1^3(I_4d_3)$	11.4	0.29	$Y_1^3(I_4d_3)$	23.8	0.35
		$Y_2^3(I_4d_3)$	19.8	0.28	$Y_2^3(I_4d_3)$	37.5	0.31

Source: author's own calculations.

The risks associated with changing the external macro-profile are combined factors that demonstrate the lack of a systemic link between government agricultural financing programs and the majority of enterprises agribusiness. This factor has a high matching factor ($C_{coherence}$ = 0.39, *Cum.* = 20.8 %), which is formed in the plane of separation of a significant proportion of enterprises from the implementation of the strategy and state agricultural development programs, which forms «60 % of the consumption fund and provides employment». The coefficient of coherence of external macro-risks relative to the financial system, the value of which equals 0.28, describes the parameters of the restriction on the formation of financial resources of enterprises agribusiness by attracting external borrowings in the financial market, inflation rates, and the cost of loans.

It should be noted that the financial crisis of 2015-2016 has had a lesser impact on lending to large agribusiness enterprises (agroholdings), the production

process of which includes the stages of harvesting, storage, processing and export of agricultural products. For example, for small and medium enterprises in 2016 in general, it became crucial in the sense of continuing existence due to reduced funding, the growth of price disparity and high taxes.

For enterprises of the first group with equal level and the best signals of the financial potential, as well as the two groups – with a stable level of risk, indicators of the state of financial system, which indicate a relatively acceptable dynamics of financial development, were more important than predictable tendencies of the domestic financial market and the inflation rate ($C_{coherence}$ = 0.43; 0.32). Concern is caused by possible decrease of market value of enterprises, loss of financial resources due to reduction of investment projects, new wave of redistribution of property in agribusiness.

Internal risks have formed the main factors - the possibility of covering production costs (compared to the amount of social expenditures) ($C_{coherence}$ = 0.42) and limiting the parameters of the formation of financial resources at the expense of domestic sources ($C_{coherence}$ = 0.39). The first factor is associated with a decrease in current costs, due to reduced salary and material consumption of products. It is believed that this can only be achieved by increasing productivity, introducing innovative technologies into production, and thus creating an effective material base for the investment attractiveness of enterprises and financing their activities. The second factor is caused by the shortage of own current assets, which, according to the expressed position of specialists-agrarians, is complicated by the achievement of break-even production ($C_{coherence}$ = 0.36), which is relevant for all groups of agribusiness enterprises. According to experts, the prospect of this factor is disappointing, as the formation of financial reserves at the expense of their own sources will depend directly on the lack of external financing.

Conclusions. Risk factors act as an unordered set of features that collectively reveal and formalize the financial paradigm. Moreover, the factor events of the external and internal environment in the field of managerial influence are integrated with the risk-set, and thus, the phenomenon of multivariate risk situations. The risks identified by the classification criteria are analyzed from the standpoint of information security, depth of research and developed system of indicators of evaluation. If the nature of the information is weakly formalized, the choice is made in favor of intuitive methods of forecasting. It should be noted that solutions obtained on the basis of heuristic methods relate to a set of acceptable solutions of prediction of risk. The availability of reliable statistical information about the risk situation contributes to the possibility of manifestation of changes in mathematical regularities. The interaction of heuristic procedures for assessing risk factors creates a plurality of flowcharts of their combined solution in constructing predictive models.

Forming lines of measuring the risk in the financial system allowed of the enterprises agribusiness to use quantitative and qualitative characteristics without limiting their possible relationships to bring alignment asymmetry of financial losses, and as a result, provide the most promising area of information processing through a combination of methods of multivariate analysis of factors. This is especially true for the system of exchange of credit information, when selecting indicators of the state of financial system of business entities in the field of agriculture. Large-scale research should become the basis for financial monitoring, development of financial forecasting systems. Participation in independent expert research and the position of enterprises agribusiness should be recognized at system of state strategic management by indicators of the sector-specific development benchmarks.

4 Список використаних джерел

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