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Determinants of Neutralizing the Influence of the Production Risks of Agricultural Enterprises on the Competitiveness Processing Industry

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Abstract

The article explores the impact of production risks in agricultural enterprises on the competitiveness of the processing industry, considering information asymmetry in an unpredictable environment. It identifies key production-stimulating elements crucial for processing industry competitiveness using the theory of value. Economic ties between agricultural enterprises and processing industry subjects aim to integrate production and technological cycles for enhanced competitiveness. The calculation of added value incorporates “Input-Output” indicators in mutual benefit flows between these entities. The article characterizes quasi-crisis pressures in the processing industry, providing indicators for economic relations between agricultural enterprises and processing industry subjects. It analyzes Ukraine's grain, oil, and animal-origin raw material production for the processing industry and assesses the country's processing industry competitiveness crisis level. The financial processes of meat-processing agricultural holdings in Ukrainian regions, excluding occupied territories, are studied, considering private foreign investments pre-war and during martial law. Changes in the competitiveness crisis level of meat-processing agroholdings are calculated, incorporating the production and technological cycle. The article concludes with anti-crisis scenarios for cross-industry interaction to neutralize competitiveness crisis factors.

Keywords: Production risks, Agricultural enterprises, System of economic relations, Processing industry, Crisis, competitiveness

1. Introduction

The competitiveness of the processing industry of any country is determined by the ability of agricultural enterprises to expand the volume of raw materials with constant destructive fluctuations in production risks, which ensure the dying of outdated forms and methods of management, but at the same time destroy the viability of a coherent system of economic relations between market participants. The risk is particularly vulnerable to the integral associations of agricultural enterprises and processing enterprises, as the impact of cyclic macroeconomic fluctuations leads to the crisis of the economic genesis of the agro-industrial complex (Janowicz-Lomott and Łyskawa (2014).

Accordingly, the cumulative influence of factors of macro and microenvironment increases the destructiveness of agricultural production, which requires the management of the determining influence of production risks of agricultural enterprises on the competitiveness of the processing industry in a holistic system of economic relations between enterprises. The deterministic process of managing the risk of agricultural enterprises and their association with processing industry into a coherent system of economic relations is a primary task of the state that regulates the internal strategy of competitiveness, as well as risks in the integration system of the macro environment.

Unfortunately, this trend cannot be accurately predicted and reliably evaluated even in the presence of a large array of indicators and tools for diagnosing economic development (Johnson et al., 2017).

At the same time, the toolkit for diagnosing the functioning of agricultural producers in the integrated system of economic relations with processing industry enterprises does not determine the levers of their sustainable development in conditions of uncertainty of the competitive environment and does not take into account the complexity of the insurance scenario. Insurance of production risks of indirect action which levels the competitive advantages of the development of agricultural enterprises, both at the state and local levels do not protect the economic interests of processing industry enterprises and also require the use of insurance functions and risk management principles. The application of this practice in the presence of an appropriate theoretical and methodological base, adapted to the realities of the economic activity of agricultural enterprises and their unification into an integral system of economic relations with enterprises of the processing industry, can have a double benefit both for integrated enterprises and for their stakeholders – both from the point of view of managing emerging risks in their economic system, and in the potential of their resource system, the formation of a sufficient amount of resource provision, the level of profitability and economic growth.

Considerable attention has been paid the cyclical competitive environment on the foundations of risk management, where the category of "risk" is studied mostly at the macroeconomic level Aditto et al., (2012), Jankelova et al., (2017), Janowicz-Lomott and Łyskawa (2014), Johnson et al., (2017), Donnell Rod (2021). The study factors vital activity of biological systems, which are the source of agricultural products and determine the probability of traditional business risks, common to all agro-industrial sector of the economy was made by A. Lorant and Farkas (2015), Martynova (2014), Nitsenko, V. Havrysh (2016). The theoretical foundations of the essence and importance of insurance as a tool to reduce the risks of production and definition probabilistic magnitude of losses was paid much attention by such scientists as: Trusova et al., (2020). The priority of our research is the development of anti-crisis scenarios of inter-sectoral interaction of agricultural market participants, which minimize the impact of production risks of agricultural enterprises, change indicators of the production and technological cycle and neutralize the crisis level of competitiveness of processing industry.

2. Materials and Methods

The development of economic relations in the chains of interaction of agricultural enterprises and subjects of the processing industry is aimed at the integration of the processes of production and technological cycles, which ensure the potential of their functioning and competitiveness. According to the concept of the theory of value, the value of the stimulating elements of production in ensuring the competitiveness of processing industry entities is distributed in the form of the following elements (Khrypiuk, 2018; Lendiel & Zhulkanych, 2015): income on invested capital (the share of profit distributed to the owners, the state, to accumulation and consumption funds, to depreciation, to the income of the land owner); in terms of income of employees; in the part of income transferred to social needs, to indirect taxes as part of the market price.

At the same time, the methodological basis of ensuring the model of competitiveness of processing industry subjects is the calculation of additional value in the supply chain of agricultural raw materials to increase the volume of processing (Kovalenko, 2018). The calculation of the added value combines the "Input-Output" indicators in the flow of bilateral mutual benefit between agricultural enterprises and subjects of the processing industry. The creation of intersectoral supply chains of agricultural raw materials and their processing is determined at the country level in the process of division of labor, which can be estimated based on the indicator of the share of intermediate imports in exports, which is usually higher for an open system of economic relations (Hrynchutskyi & Blashchak, 2018).

The methodology for calculating the added value in the supply chain of agricultural raw materials to increase the amount of processing allocates a system of indicators: indicators of the participation of processing industry subjects in global value chains; indicators of the gradual integration of agricultural enterprises into the chain system of processing industry entities; indicators of reverse integration; indicators of the origin of added value of processing industry entities in gross exports and in final demand; indicators of added value in domestic exports (Nelson et al., 2017).

Interested participants of intersectoral integration are aimed at the formation of an integrated system of economic relations that neutralize production risks based on a set of interacting components that have a multifactorial impact on the competitiveness of the processing industry, in particular (Khrypiuk, 2018; Lendiel & Zhulkanych, 2015): neutralization of the risks of the competitiveness of services for the supply of agricultural raw materials in accordance with the assessment criteria (price, quality, cost), neutralization of risks in resource potential (technology, finance, information, personnel), neutralization of risks of after-sales service, neutralization of risks of competitiveness of organizational potential (organizational structure, organizational joint interaction of interested parties, organizational form of management, functional structure), neutralization of risks of competitiveness of communication relations (with suppliers, investors, consumers, contact objects), neutralization of risks of competitiveness of the management

system (management mechanism, stage of management, ability to form and use opportunities, predict the rhythm and timely respond to changes, development and provision management subsystems and strategic direction of management).

The deterministic impact of production risks of agricultural enterprises on the competitiveness of the processing industry generates a high dynamic of information asymmetry, which actualizes the problems of a complete system of economic relations between subjects in the event of un-predictable changes in the set of factors of the external environment. This makes it possible to identify the causes that lead to crisis phenomena, and, accordingly, to the need to implement anti-crisis measures in the processing industry with the aim of leveling conflicts in branches and sub-branches of the agro-industrial complex (absence or poor-quality strategy and tactics of actions regarding unfair competition, which leads to the unpredictability of the situation as part of anti-crisis risk management), with the aim of clearing the market of weak competitors and developing a stable food system in the country (Halchynskyi, 2009; Witteloostuijn & Wegberg, 1992). The impossibility of promptly evaluating alternative scenarios of the deterministic impact of production risks of agricultural enterprises on the competitiveness of processing industry enterprises limits the acceleration of economic processes and the connections between them in accordance with the established rules and norms of regulation of a stable production and technological cycle (Hermann, 2015; Hrynchutskyi & Blashchak, 2018).

The need to develop an integrated economic system of relations between subjects, based on mutually agreed and complementary principles, covers a wide range of regulatory instruments to influence the sectors and sub-sectors of the agro-food sector, and especially the processing industry. This requires a radical revision of the approaches to the transformation of the methodology of establishing the standards of competitiveness of large processing enterprises under the determining influence of production risks of agrarian business entities, oriented to the hierarchical agreement between the target orientations of the development of agriculture and their integration into the mechanism of strategic, medium-term and indicative planning of the processing industry (Martynova, 2014; Nitsenko & Havrysh, 2016; Zhmudenko, 2015).

This increases the uncertainty of future conditions, causes the probability of a crisis at various levels of the system of economic relations, which objectively requires a change in the principles of anti-crisis management both at the level of enterprises and at the level of regions and the country in general (Janowicz-Lomott & Łyskawa, 2014; Kholod & Shtanhret, 2002). Many export-oriented agricultural and processing enterprises are experiencing an economic downturn, with the slightest changes in world commodity markets. In order to ensure dynamic balance, that is, minor changes in the parameters of the system of economic relations between agricultural enterprises and subjects of the processing industry, as a result of the interaction of factors-threats of external pressure; it is necessary to quickly mobilize internal factors to neutralize production risks (Martynova, 2014).

Threats that in a competitive environment exert quasi-crisis pressure on the parameters of the system of economic relations between agricultural enterprises and subjects of the processing industry at the level of the agro-food sector of the economy are divided into three blocks according to the nature of competition (Shtymer, 2011): 1) financial capital; 2) intellectual capital; 3) rating positions in the system of profit redistribution in the agricultural market (Figure 1).

Human resources, financial and intellectual capital are mobile resources of the processing industry. Blocking their entry by competitors means creating conditions that significantly affect the redistribution of the flow of capital and labor in favor of processing industry entities (preferential taxation of foreign direct investments (FDI), special programs for attracting highly qualified workers). If competitors eliminate such measures, then the redistribution of part of the resources goes to other branches of the agro-industrial sector of the economy (Witteloostuijn & Wegberg, 1992).

In order to counteract the anti-crisis pressure in the production activity of agricultural enterprises, as suppliers of agricultural raw materials for the processing industry, they single out their urgent needs for raw materials, which are included in variable costs in the production and technological cycles. At the same time, to ensure resource needs for agricultural enterprises, the concept of restrictions applies, which also imposes certain restrictions on the state of operation of the technological cycle of processing industry subjects. This determines their ability to compete in an environment of restrictions among other subjects of the agro-food sector of the economy and to meet current and future needs (Kholod & Shtanhret, 2002; Yevtushenko et al., 2016).

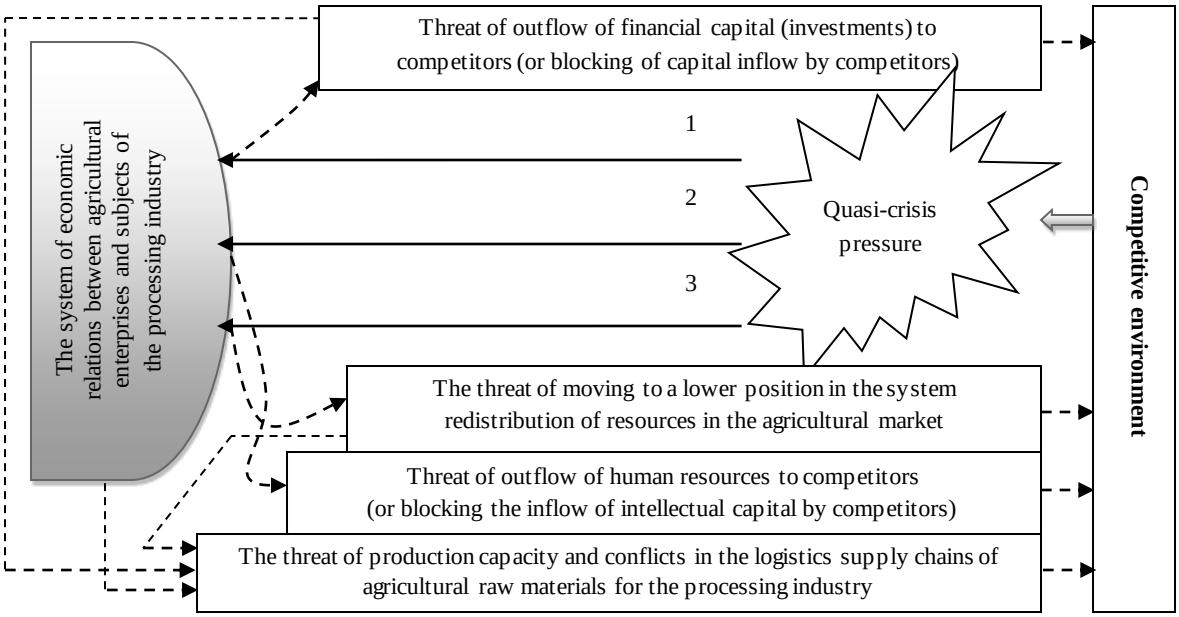

Figure 1. Quasi-crisis pressure in the competitive environment of the processing industry
Source: developed by the authors

The concept of restrictions in countering the quasi-crisis pressure partially alleviates the limitation of resources (including natural ones) that enter the system of economic relations between the subjects of the processing industry and agricultural enterprises, which have full rights to agricultural land due to the regulation of legal norms and use natural resources due to internal sources (Sivash et al., 2019). Therefore, in order to prevent the development of crises associated with the lack of natural resources for the full production cycle by agricultural enterprises, it is necessary to take into account the possible threats created by the competitive environment (production capacity and the technological cycle of the processing industry depend on the volume of agricultural production). Thus, quasi-crisis pressure combines an approach to competition as a competition for a ranking position in the redistribution of resources between agricultural enterprises and processing industry subjects, as well as from the management of the development of the system of economic connections between them, from the standpoint of preventing risk phenomena.

The competitive environment in the agro-food sector of the economy dialectically affects the frequency and severity of risk phenomena in the system of economic relations. This impact is due to (Shpachuk, 2010; Shmahlii, 2017): 1) the strengthening of the "chain effect" of risk (due to the strengthening of the interconnection of individual elements); 2) the emergence and development of a system of economic relations of the highest rank – the national economy, for which risks are an objectively determined stage of evolutionary development; 3) increased quasi-crisis pressure (as a result of changes in competition under the influence of global challenges in the world). In addition, the constant threat of reducing the resources necessary for the functioning of the system of economic relations between agricultural enterprises and subjects of the processing industry brings to the fore the long-term (strategic) horizon of production risk management, focused on ensuring the minimum amount of resources to counteract the constant quasi-crisis pressure.

Within the framework of the theory of competition based on resource advantages (Hunt, 2000) (R-A theory, theory of resource advantages), it is possible to create new anti-risk measures that ensure high financial results, both for agricultural enterprises and for subjects of the processing industry without benefits for the redistribution of resources on the agricultural market. With the help of such an approach, it is possible to substantiate the need for anti-crisis measures, as a permanent comprehensive response to crisis phenomena and the factors that generate them. The R-A theory in the system of economic relations between agricultural enterprises and subjects of the processing industry is a set of ranked positions α, β, $\gamma \ldots \omega$, each of which is characterized by its own set of aggregate resources, consumers, intermediaries, financial, information and other institutions. In general, the R-A theory determines the share of total resources (including financial income) that can be obtained by both agricultural enterprises and processing industry entities operating in a certain area of the agricultural market (Hunt, 2000).

Achieving an advantageous position in a competitive environment, the system of economic relations between subjects of the processing industry and agricultural enterprises during the redistribution of resources (positions α, β, $\gamma \ldots \omega$) provides conditions under which competitors lagging behind the leader cease their activities. In addition, they occupy an unfavorable position in the system (for example, δ or ω) or participate in competition for a position of higher rank (for example, α) or compete with other competitors for holding positions. The introduction of a discrete set of ranked positions in the system of economic relations between subjects of the processing industry and agricultural enterprises simplifies the determination of the competitive position using the method of comparison with other competitors or a standard (Hunt, 2000).

It is advisable to introduce a competitive space of the system of economic relations between subjects of the processing industry and agricultural enterprises, at each point of which there can only be a united enterprise (agroholding). However, such an approximation can be modeled as a set of ranked positions (for example, a position allows a firm to gain greater access to resources). Accordingly, competition between joint enterprises (agroholdings) can be defined as competition for a share of resources that are redistributed through a system of economic ties between subjects of the processing industry and agricultural enterprises of a higher rank. Thus, competition between joint enterprises (agroholdings) is a competition for a share of resources (monetary, material, human), which are redistributed through the respective agricultural markets of the country or through world markets. Individual agricultural enterprises and subjects of the processing industry, which do not function in an integrated system of economic relations, have fewer resources than are necessary to counter the quasi-crisis pressure.

In this case, production risks arise constantly, in hyper competition, which is a multi-system structure, with a geographical gap in the logistic chains of product promotion (Halchynskyi, 2009). If we translate the multi-system economic relations between agricultural enterprises and subjects of the processing industry into the plane of competitiveness risk neutralization according to the terms of its occurrence and rating α, β, $\gamma \ldots \omega$, then this will mean that the rating of each united enterprise (agroholding) is determined by a set of critical state of competitiveness lower order (coordinate). Thus, the competitive space becomes multidimensional, which complicates the set of trajectories along which the competitive positions in the ranking change (Hunt, 2000; Janowicz-Lomott & Łyskawa, 2014).

All this determines the importance of assessing the effectiveness of anti-risk actions in the agro-industrial sector of the economy, which are regulated by the state and which counteract the quasi-crisis pressure in the current and future periods. To assess such compliance, the methodological approach called the "dynamic standard method" (Martynova, 2014) is the most suitable, which allows the system of economic relations between agricultural enterprises and processing industry subjects to develop ideally. The real trajectory of system development may be similar to the ideal one.

Accordingly, the effectiveness of the chosen strategy for the development of the system of economic relations between agricultural enterprises and processing industry entities is evaluated by the degree of similarity: the closer the development of the system is to the ideal trajectory, the higher the effectiveness of the strategy, and vice versa. To assess the trajectory of the strategic development of the system of economic relations between agricultural enterprises and subjects of the processing industry and to prevent risky events in a competitive environment, it is advisable to use five indicators (Table 1).

The quantitative value of the correspondence of the development of the system of economic relations between agricultural enterprises and subjects of the processing industry, from the standpoint of anti-crisis scenarios of inter-sectoral interaction of agricultural market participants in a competitive environment, is calculated as the normalized degree of similarity between the matrices S:

$$S = \left(1 - \frac{\sum_{i=1}^{m} \sum_{j=1}^{m} \left| F_{ij} - N_{ij} \right|}{2 \times R} \right) \times 100, \qquad (1)$$

where, F_{ij}, N_{ij} – the elements of the actual and reference matrices, respectively; m – the total number of indicators selected for evaluation; R – the number of elements of the reference matrix, the value of which is non-zero.

Table 1. Indicators of the development of the system of economic relations between agricultural enterprises and subjects of the processing industry from the standpoint of anti-crisis scenarios of inter-sectoral interaction of agricultural market participants in a competitive environment

Indicator	Indicator	Correlation	Interpretation of ratios of the indicators
1	Export of products (X_1)	$D(X_1) \geq D(X_2)$	The share of agricultural enterprises and subjects of the processing industry increases during the redistribution of resources in the agricultural market.
2	GDP, (X_2)	$D(X_2) \geq D(X_3)$	Increasing the productivity of the use of the production cycle of agricultural enterprises and the production capacities of processing industry subjects in the presence of aggregate human capital and financial resources.
3	Capital Investments, (X_3)	$D(X_3) \geq D(X_4)$	An increase in human capital, an increase in the amount of financial resources involved, which are directed to the expansion of the production and technological cycle.
4	The amount of FDI, (X_4)	$D(X_4) \geq 1$	Agricultural enterprises and subjects of the processing industry in an integral system of economic relations attract more financial resources from the world market
5	The share of the economically active population that is involved in the production and technological cycle of the combined enterprises of the processing industry, (X_5)	$D(X_5) \geq 1$	Growth of employment and increase of human capital in the combined enterprises of the processing industry.

Note. $D(X_i)$ – the growth rates of indicators, % to the previous period.

Source: developed by the authors

If $S = 100\%$, then the development of the system of economic relations between agricultural enterprises and subjects of the processing industry (the system of the national agro-food sector of the economy or the system of another rank) corresponds to anti-crisis scenarios of inter-sectoral interaction of agricultural market participants in a competitive environment. In another case ($S = 0\%$) the dynamics of the system does not fully correspond to the anti-crisis scenarios of inter-sectoral interaction of agricultural market participants in a competitive environment.

A combined methodical approach to the implementation of anti-crisis scenarios of inter-sectoral interaction of agricultural market participants is proposed in order to determine the optimal parameters of an open three-sector model, which takes into account the sufficiency of resources in the system of economic relations between agricultural enterprises and subjects of the processing industry in a competitive environment. The insufficient development of this system is one of the determining factors of the risk of competitiveness of the combined enterprises (agroholdings) of the processing industry, under the influence of quasi-crisis pressure. According to this model, from the point of view of sectoral development of agricultural enterprises and subjects of the processing industry, anti-crisis scenarios of inter-sectoral interaction of agricultural market participants are divided into: material (zero) – production (agricultural raw materials, semi-finished products, other consumables in the production process); fund-forming (first) – production of fixed assets (buildings, structures, machines, equipment, energy devices, other industrial investment resources); consumer (second) – production of consumer goods. In this case, the technological component of the competitiveness of the combined enterprises (agroholdings) of the processing industry is considered invariant with the help of linear homogeneous neoclassical functions (subsystems) (Shpachuk, 2010; Vitlinskyi & Verchenko, 2000):

$$X_i = F_i(K_i, L_i), i = 0,1,2, \quad (2)$$

where, X_i, K_i, L_i – is the volume of production at market prices, physical capital and the number of employed people in the i-th united enterprise (agroholding) of the processing industry.

Since as the basic parameters of the model we take similar functions (1) (Shpachuk, 2010), we must assume that time changes continuously, the investment lag is zero, and the depreciation coefficients of fixed capital in the

processing industry are growing. The employment rate of the economically active population in the processing industry is a constant value. In addition, we assume that the depreciation coefficients are the same, and the quota coefficient for the import of investment resources and the ratio of world prices for agricultural raw materials (semi-finished products of the processing industry) and investment resources are constant.

The following elements have been introduced: ν – the growth rates of employment of the able-bodied economically active population in the processing industry (i.e., according to the model (Yevtushenko et al., 2016), $L = L(t) = L(0)e^{\nu t}$); $\theta_i = \frac{L_i}{L}$ – the share of the *i*-th joint enterprise (agroholding) of the processing industry in the distribution of human resources in the agro-food sector of the economy; s – the share of the *i*-th joint enterprise (agroholding) of the processing industry in the distribution of investment resources in the agro-food sector of the economy; $k_i = \frac{K_i}{L_i}$ – the sectoral labor productivity of the *i*-th united enterprise (agroholding) of the processing industry; $\frac{x_i}{L_i} = F_i(k_i, 1) = f_i(k_i)$ – the share of import of agricultural raw materials in the total volume of raw materials of the joint enterprise (agroholding) of the processing industry; $y_0 = \frac{Y_0}{L}$ – the share of import of investment resources in the total amount of investments of the joint enterprise (agroholding) of the processing industry; $y_1 = \frac{Y_1}{L}$ – the share of import of semi-finished products in the total volume of products of the joint enterprise (agroholding) of the processing industry; $y_2 = \frac{Y_2}{L}$ – the coefficient of quota of agricultural raw materials; γ_0 – import quotas of investment resources; γ_1 – the quota coefficient of import of semi-finished products; γ_2 – is share of export of agricultural raw materials (semi-finished products) of the joint enterprise (agroholding) of the processing industry; z_0 – is world price of exported semi-finished products (agricultural raw materials); q_0 – is world prices for imported investment resources, agricultural raw materials (semi-finished products); q_1^+, q_2^+ – is direct production costs per unit of production of the *i*-th united enterprise (agroholding) of the processing industry; a – is depreciation rate of fixed capital (the same for all combined enterprises (agroholdings) of the processing industry); μ – is coefficient of depreciation of physical capital (the same for all sectors); $\lambda = \mu + \nu$ – is coefficient of reduction of capital equipment due to depreciation of fixed capital and increase in the number of employees.

The share of produced products per one united entity of the processing industry in the agro-food sector of the economy is introduced (Shpachuk, 2010; Vitlinskyi & Verchenko, 2000):

$$x_i = \frac{X_i}{l} = \theta_i f_i(k_i), i = 0, 1, 2, \quad (3)$$

where, x_i – is the productivity of the *i*-th united enterprise (agroholding) of the processing industry in the agro-food sector of the economy.

The dynamic trend of accumulation of investment resources by joint enterprises (agroholdings) of the processing industry in the agro-food sector of the economy is determined by the differential equation (Shpachuk, 2010; Vitlinskyi & Verchenko, 2000):

$$\frac{dk_i}{dt} = -\lambda k_i + \frac{s_i}{\vartheta_i}(x_i + y_i), k_i(0) = k_i^0 \; i = 0, 1, 2., \quad (4)$$

Accordingly, the equation of the balance of the use of resources for the formation of the competitiveness of the combined enterprises (agroholdings) of the processing industry in the agro-food sector of the economy will have the following form for (Shpachuk, 2010; Vitlinskyi & Verchenko, 2000):

$$\theta_0 + \theta_1 + \theta_2 + \theta_i = 1, 0 \le \theta_i \le 1, \quad (5)$$

the balanced supply of economically active human resources (Yevtushenko et al., 2016):

$$s_0 + s_1 + s_2 + s_i = 1, 0 \le s_i \le 1, \quad (6)$$

the balanced supply of supply of agricultural raw materials (balance of production):

$$(1 - a_0)x_0 = a_1x_1 + a_2x_2 + a_ix_i + z_0, \quad (7)$$

the balanced supply of agricultural raw materials and semi-finished products of the processing industry to the world market:

$$q_0z_0 + q_1^+z_1 + q_2^+z_2 + q_i^+z_i = q_0y_0 + q_1^+y_1 + q_2^+y_2 + q_i^+y_i, \quad (8)$$

the balanced supply of agricultural raw materials and resources:

$$y_0 \le \gamma_0 x_0, \quad (9)$$

the balanced provision of technological equipment:

$$y_1 \le \gamma_1 x_1, \quad (10)$$

the balanced provision of the domestic agricultural market with products of the processing industry (Shpachuk, 2010; Vitlinskyi & Verchenko, 2000):

$$y_2 \le \gamma_2 x_2, \quad (11)$$

Therefore, the system of economic relations between subjects of the processing industry and agricultural enterprises depends on the competitive environment. At the same time, no less important in the future period are anti-crisis scenarios of inter-sectoral interaction of agricultural market participants, which allow combining agricultural enterprises and subjects of the processing industry into agroholdings in order to prepare them for a crisis during a probable conflict (in particular, an armed conflict in the country).

Since the system is constantly under quasi-crisis pressure both from within the country (due to internal contradictions) and from the outside (from competitors), the anti-crisis scenarios of inter-sectoral interaction of agricultural market participants are designed to coordinate the main sources of resource formation to counteract this pressure in a competitive environment. However, it should be remembered that anti-crisis scenarios of intersectoral interaction of participants in the agricultural market of any country may face hyper-competition of the world market, since in most countries of the world, with a sufficiently developed agro-food sector of the economy, there are restrictions on the production of resources that are distributed among all competitors, and their number is increasing under globalization.

3. Results and Discussion

Transformational processes in the agro-food sector of the economy of Ukraine caused by crisis phenomena and associated with the full-scale military invasion of the aggressor country on the territory of the state, provoked a threatening trend of decline in the production of agricultural enterprises. This had negative consequences for the competitiveness of the processing industry. According to the structure of the consumer basket, the level of provision of agricultural and processing industry products in Ukraine is deteriorating. So, if the amount of meat and milk decreases, then the processing products of the grain and oil group increase, causing a shortage of proteins, vitamins, macro- and microelements of animal origin, which leads to "hidden hunger" (Hrynchutskyi & Blashchak, 2018).

In addition, negative dynamics of food quality deterioration are observed. During the period 2000-2022, the share of consumption of products of animal origin was lower than the established norm and varied within 23.0-29.7%. In 2022, the average per capita consumption of food products decreased in almost all food groups, in particular, the annual consumption of meat decreased by 55% (beef and poultry, especially low-fat varieties of meat), milk – by 51%, fish – by 46%, eggs – by 16%, vegetables – by 8%, fruits – by 55%, sugar – by 36%.

The production of products of the grain and oil group is the main raw material for the processing industry. However, in 2022, almost 12 million hectares of arable land were lost due to military operations and the occupation of the Southern regions of Ukraine. This caused the loss of 72.4% of agricultural raw materials for the grain-processing and oil-processing sub-sectors of the agro-food sector of Ukraine (Figure 2).

For example, the volume of beef production in 2018-2023 decreased by 10.1%, pork – by 23.5%, poultry – by 6.6%, and milk – by 49.1%. In 2022, in Ukraine, the raw material component of agricultural enterprises in the field of animal husbandry, in relation to the level of 2021, suffered large losses. Accordingly, meat processes and milk processing complexes in Ukraine received raw materials from agricultural enterprises in the following proportion: beef meat – by 25.0%, pork – by 42.0%, poultry – by 32%, milk – by 18.9%. In 2023, in relation to 2022, a slight increase in the volume of production of raw materials of the livestock industry for the meat processing sub-complex of the agro-food sector of the economy was outlined. Thus, beef production increased by 34.9%, pork – by 31.1%, poultry – by 13.4%.

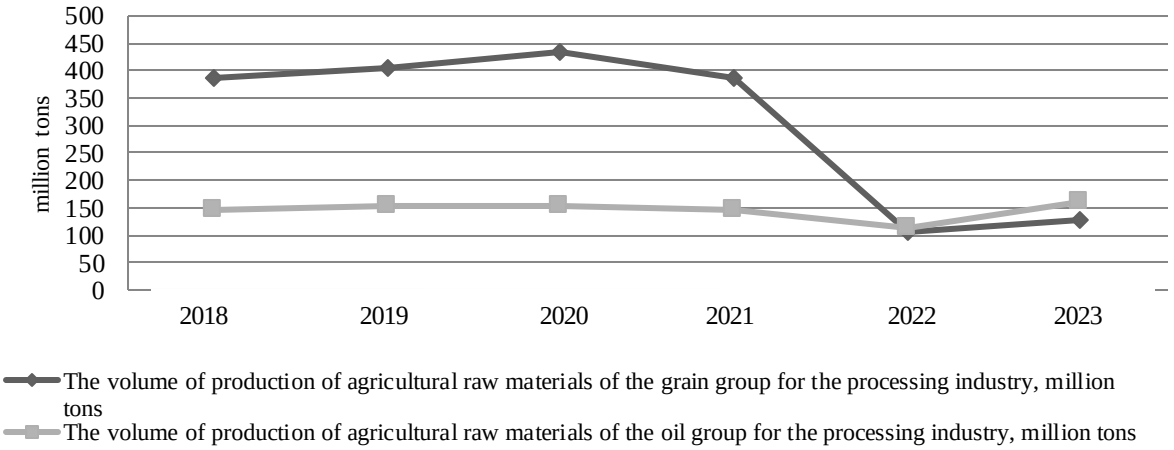

Figure 2. Volume of production of agricultural raw materials of the grain and oil group in the Ukraine for the processing industry in 2018-2023, million tons

Source: built by the authors from the data (State Statistics Service of Ukraine, 2018; 2019; Government portal, 2021)

The volume of production by agricultural enterprises of raw materials of livestock origin for the meat processing industry of Ukraine is presented in Figure 3.

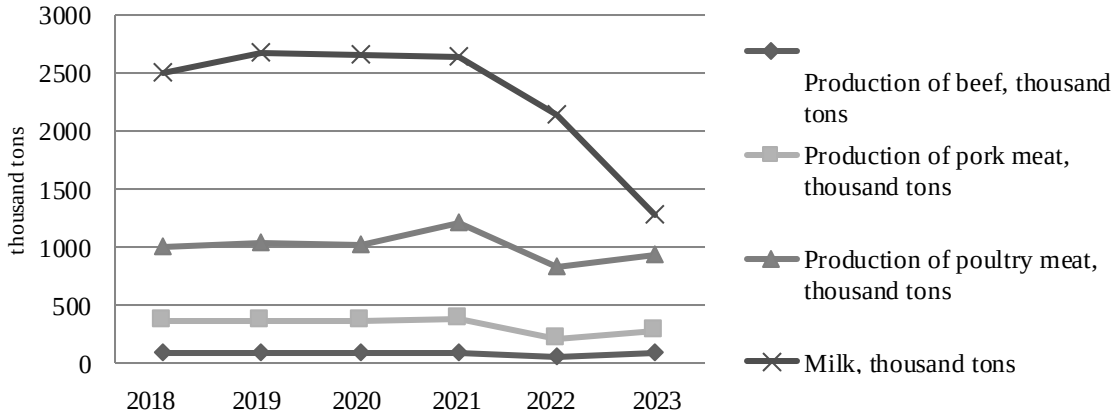

Figure 3. Volume of production of raw materials of animal origin for the meat processing industry of Ukraine for 2018-2023, thousand tons

Source: built by the authors from the data (State Statistics Service of Ukraine, 2018; 2019; Government portal, 2021)

The space for neutralizing the crisis of the competitiveness of the meat processing industry in Ukraine is the final result of the activities of the participants of the agricultural market, which is formed in the system of limited resources of agricultural enterprises that are included in the integral infrastructure of the meat processing industry. At the same time, the polarized space of the meat processing industry in the market of meat products and semi-finished products must meet the needs of consumers in accordance with the established regulatory volume, while maintaining the opportunity to expand its own capabilities in the country and beyond. Thus, after the decline of meat processing production in Ukraine from 2022, in 2023, its growth by 15.5% is observed. Ukrainian producers of the meat processing industry have potential opportunities to enter the world markets of beef products in the USA, Germany and Switzerland. One of the important aspects of state policy in the meat processing industry as a whole is the composition, dynamics and structure of import and export of meat products in Ukraine (Figure 4-5).

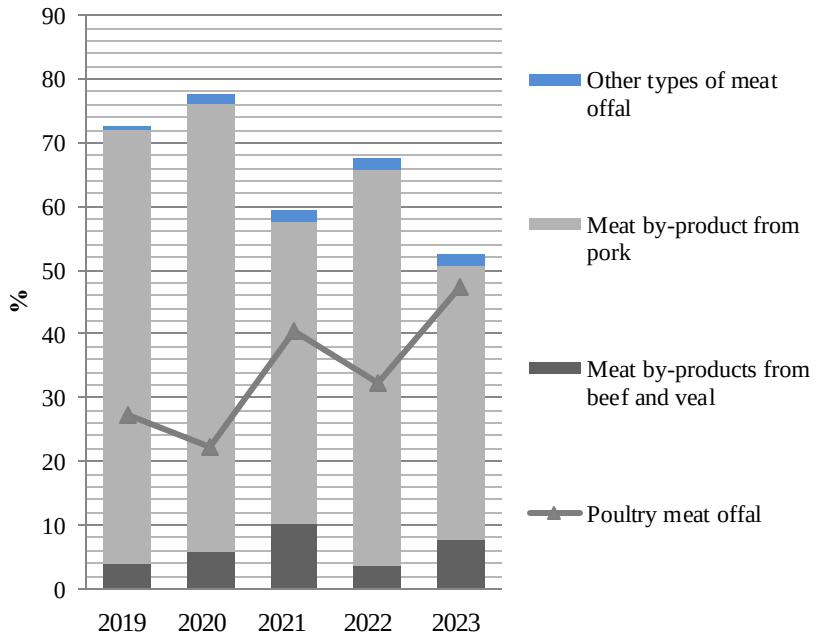

Figure 4. Imports of meat processing products in Ukraine, %

Thus, the export of beef and veal offal in 2019-2023 increased by only 17%, from pork - decreased by 70%, and from poultry meat – increased by 21%. In 2022, compared to 2021, the export of by-products of meat processing complexes decreased by all types: beef and veal – by 24%, pork – by 82%, poultry meat – by 23.7%. In 2023, compared to 2022, there is a tendency to increase the export of these types of meat processing products: beef and veal – by 28.2%, pork – by 2.3 times, poultry meat – by 56.8%. Poultry products continue to be supplied to Egypt and EU countries.

The level of the crisis of competitiveness of the entities of the processing industry of Ukraine in the conditions of the martial law of Ukraine (2022-2023) ranged from approximately 9.1% to 16.0%, while in 2021 it was 3.3%, and in 2020 – only 0.5%. The real share of the manufacturing industry in GDP in 2022 decreased by 29.1%, while in 2020 it was 19.4%, in 2021 it was 13.9%. At the same time, the fluctuations of the consumer price index for the products of the processing industry had a dynamic nature.

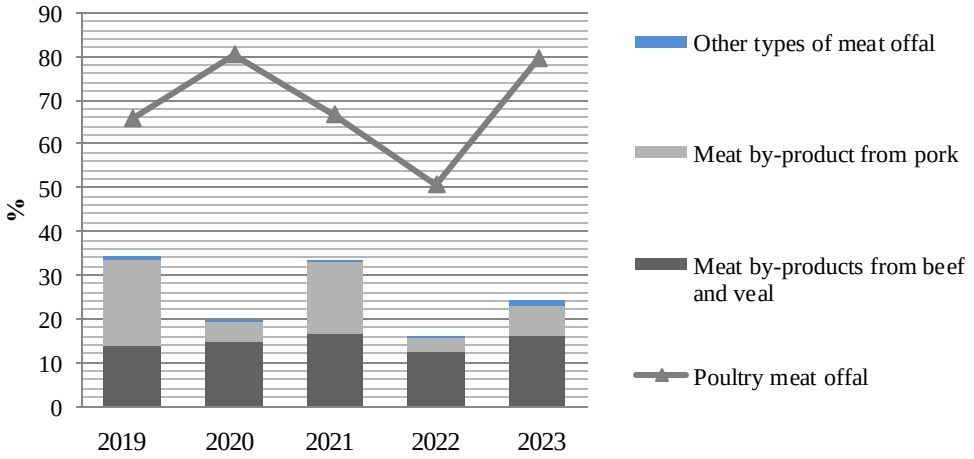

Figure 5. Exports of meat processing products in Ukraine, %

Source: compiled by the authors according to data (State Statistics Service of Ukraine, 2018; 2019; Government portal, 2021)

Thus, in 2020-2021, the prices for the products of the processing industry increased by 2.4% and by 10%, respectively, in previous years. In 2022, due to hostilities in the country, consumer prices for processed products rose 2.7 times. In 2023, due to the shortage of Ukrainian agricultural raw materials, the greater part of which was supplied from the regions of the Steppe zone of Ukraine, the price trend for processed products increased by 6% from the level of 2022 (Figure 6).

The financial component of the level of competitiveness, which ensures the performance of the production and technological cycle in meat-processing sub-complexes united with agricultural enterprises (agroholdings), is formed at the local level and depends on the competitive environment in the domestic market of Ukraine (Figure 7).

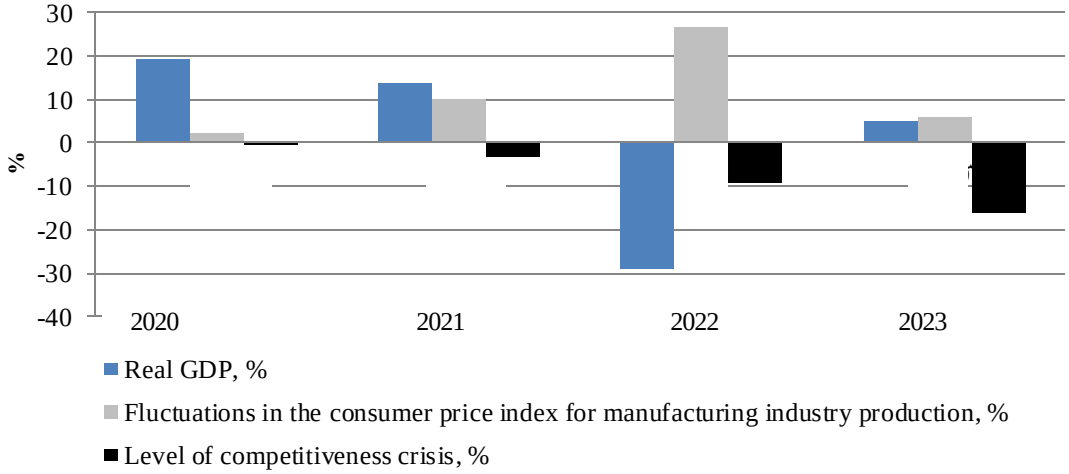

Figure 6. The level of the crisis of competitiveness of the processing industry of Ukraine for 2021-2023, %

Source: built by the authors from the data (State Statistics Service of Ukraine, 2018; 2019; Government portal, 2021)

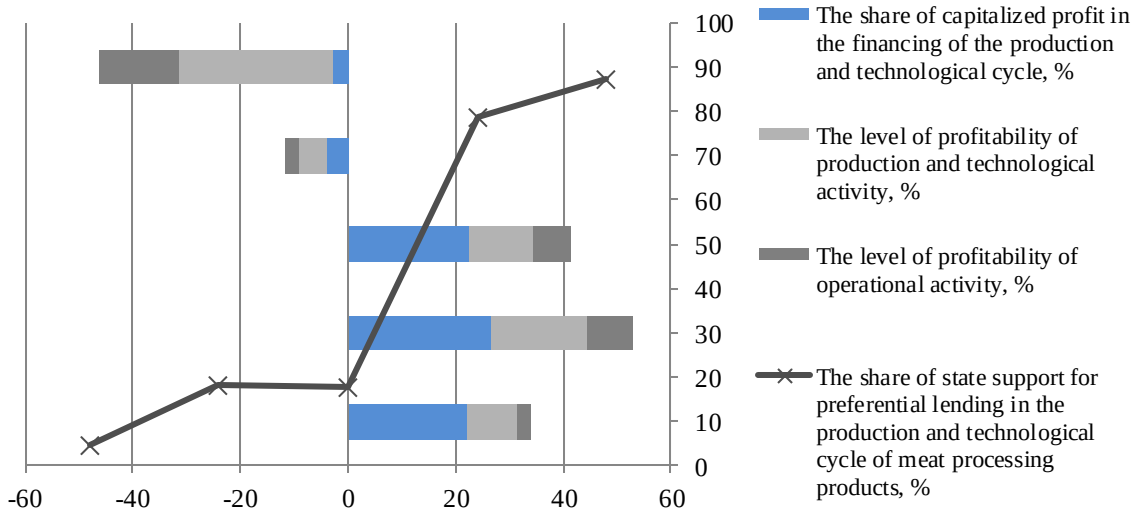

Figure 7. Financial process of the production and technological cycle in meat-processing sub-complexes united with agricultural enterprises (agroholdings) for 2019-2023, %
(on average for the region of Ukraine without taking into account the occupied territories)

Source: compiled by the authors according to data (State Statistics Service of Ukraine, 2018; 2019; Government portal, 2021)

At the same time, neutralization of the competitiveness crisis in Ukrainian meat-processing agroholdings is taking place with the participation of private foreign investments. This makes it possible to ensure a low level of risk, quick payback of costs in the production-technological cycle and costs for the sale of products for Ukrainian and foreign consumers (Figure 8-9).

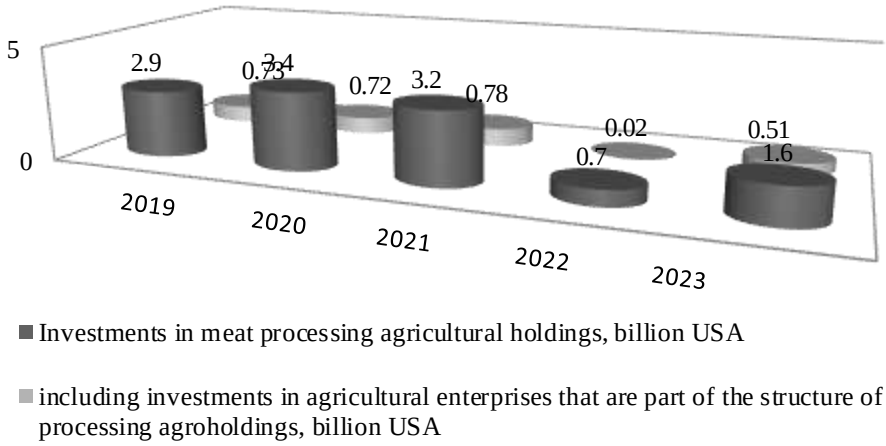

Figure 8. The volume of private foreign investments in meat-processing agroholdings of Ukraine for 2019-2023, billion USA

Source: compiled by the authors according to data (State Statistics Service of Ukraine, 2018; 2019; Government portal, 2021)

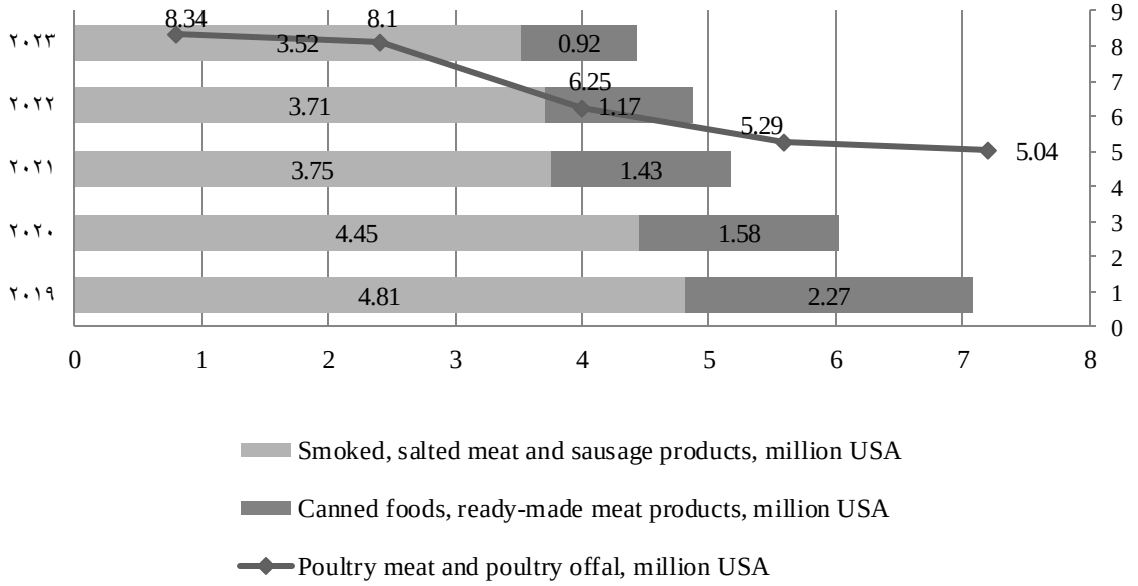

Figure 9. The volume of sales of products by meat-processing agroholdings on the Ukrainian and foreign markets for 2019-2023, million USD (with the support of private foreign investors)

Source: compiled by the authors according to data (State Statistics Service of Ukraine, 2018; 2019; Government portal, 2021)

In order to neutralize the crisis in the competitiveness of meat-processing agricultural holdings in the integrated system of economic relations with agricultural enterprises that are part of their structure, it is necessary to adhere to the optimal guidelines of the production and technological cycle and take into account the level of financial support from both private investors and the state under preferential lending.

Discussion

The system of economic relations between agricultural enterprises and subjects of the processing industry allows forming their competitiveness as joint enterprises (agricultural holdings) in the agricultural market. At the same time, they can create risks in the production and technological cycle, which, with the help of regulatory insurance tools, neutralize the emergence of a competitiveness crisis. For a more in-depth interval assessment of minimization of the crisis of competitiveness of the combined enterprises (agroholdings) of the processing industry, density curves of the distribution of the probability of accidental losses are constructed; the risk zone is determined.

The intersection of the function $f(x_1)$ and the value of the crisis of competitiveness in the case of a negative consequence (x_1) (intersection 1) – characterizes the most likely losses in the production-technological and financial cycle and risk neutralization with the expected competitiveness of the combined enterprises (agroholdings) of the processing industry on the agricultural market. The intersection of the function $f(x_{add})$ and the value of the loss in the event of a negative consequence (x_{add}) (intersection 2) – corresponds to the permissible crisis point of the competitiveness of the combined enterprises (agroholdings) of the processing industry on the agricultural market, at which the losses will be equal to the sum of the loss of production, technological and financial resources (point is the upper limit (zone) of a permissible crisis of competitiveness) (Yastremskyi, 1992).

The probability of a crisis in the competitiveness of the combined enterprises (agroholdings) of the processing industry on the agricultural market $f(x_{add})$ is determined by the dependence (12), (Yastremskyi, 1992)

$$f(x_{add}) = \int_0^{x_{add}} f(x)dx \ , \qquad (12)$$

The zone of admissible crisis of competitiveness is the zone within which the activity of the combined enterprises (agroholdings) of the processing industry on the agricultural market does not exceed the value of the loss of production, technological and financial resources. The intersection of the function $f(x_{kr})$ and the size of the loss of resources in the production and technological cycle is the same in the event of a negative consequence (x_{kr}), (intersection 3) – characterizes the degree of the permissible crisis level of competitiveness of the combined enterprises (agroholdings) of the processing industry on the agricultural market (i.e., the risk of financial losses, which is equal to the estimated amount of income when the competitiveness crisis is neutralized) (Yastremskyi, 1992).

The probability of the critical limit of the crisis level of competitiveness $f(x_{kr})$ is determined by dependence (13):

$$f(x_{kr}) = \int_{x_{add}}^{x_{kr}} f(x)dx \ , \qquad (13)$$

The intersection of the function $f(x_{dis})$ and the value of the loss of resources in the production and technological cycle in the event of a negative consequence (x_{dis}), (intersection 4) – characterizes the catastrophic-crisis level of competitiveness (i.e., the risk of financial losses equal to the aggregate amount of resources of the combined enterprises (agroholdings) of the processing industry).

The probability of a catastrophic-critical level of competitiveness $f(x_{dis})$ is determined using the integral (formula (14)) (Yastremskyi, 1992)

$$f(x_{dis}) = \int_{x_{kr}}^{x_{dis}} f(x)dx \ , \qquad (14)$$

According to the multi-level diagnosis of the crisis of the competitiveness of meat-processing agroholdings in the integral system of economic relations with agricultural enterprises, the authors of the study identified meat-processing agroholdings and determined multi-vector changes by types of production and technological cycle (Davydov, 2017). A multi-level diagnosis of the competitiveness crisis was carried out at 15 meat-processing agricultural holdings located in 15 regions of Ukraine. To form a structural-parametric configuration by types of production-technological cycle, 7 meat-processing agricultural holdings were selected, which during 2021-2023 implemented technological changes in production activities with subsequent marketing of products on the Ukrainian and foreign markets.

Poly-vector changes in the competitiveness crisis of meat-processing agricultural holdings (I_{cc}), which is determined by the integral indicator of ensuring the production and technological cycle in the time interval of 2021-2023, is presented in Figure 10. The integral indicator includes capitalized profit, state preferential lending, but without financial support private investors.

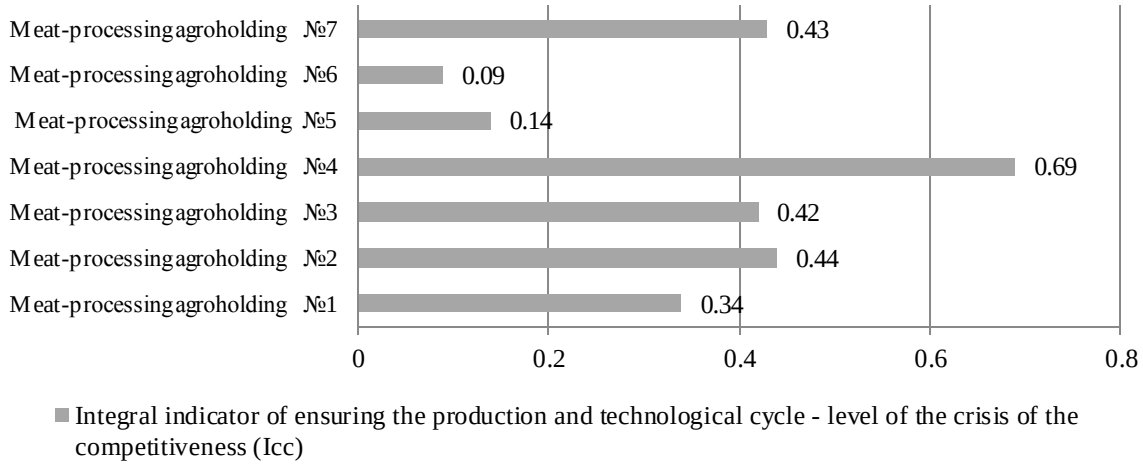

Figure 10. Poly-vector changes in the level of the crisis of competitiveness of meat-processing agroholdings according to the integral indicator of ensuring the production and technological cycle in the time interval 2021-2023 (without taking into account the amount of financial support of private investors and taking into account capitalized profit and state preferential lending)

Source: calculated by the authors

Thus, 7 meat-processing agricultural holdings in the regional space of the system of economic relations with agricultural enterprises have an average and high crisis level of competitiveness, since the value of the indicator is less than zero ($I_{cc} \le 0$).This trend persists during the time period of 2021-2023. This indicates that the combined subjects of the meat processing industry do not have enough own and engaged resources to optimize the production and technological cycle, which requires innovation and changes in technological capabilities with the aim of constant increasing its positions on the Ukrainian and foreign markets. They require private investment and additional insurance regulators from the state.

As a rule, production and market risks affect the production of agricultural and processing products in different ways and, accordingly, their negative impact in some areas is compensated by positive in others. In order to minimize production risks, obtain stable financial results and competitive advantages, both agricultural enterprises and enterprises of the processing industry determine the criteria of specialization when implementing outsourcing, while maintaining existing methods and production volumes (Vereshchaha et al., 2019). Instead, the diversification of production and technological cycles has both economic and social benefits – it provides more employment, the realization of a wider spectrum of social and material needs of producers of the agro-industrial sector.

A number of characteristic features of ensuring the competitiveness of the processing industry, such as a long period of capital turnover and a high risk of dependence of production cycles on the supply of raw products of agricultural enterprises, determine the need for additional resources. The dynamic development potential of the processing industry requires an increase in the amount of cash and commodity resources every year, but its risks are not covered by loan resources, so insurance is almost the only alternative source of compensation for the loss of raw materials when the supply chains of material resources are broken and competitiveness risks are minimized. Increasing the effectiveness of the protection of the integral system of economic relations is in the interests of both agricultural producers and enterprises of the processing industry for the development of the risk management mechanism.

Insurance, like other risk transfer tools, relies on risk aversion. Meat-processing agricultural holdings, integrated into economic relations with agricultural enterprises, exhibit a negative attitude towards potential economic fluctuations. They are willing to compromise to mitigate significant fluctuations that could impact competitiveness. This is reflected in the principle of useful expectations, where decision-making agroholdings assess the usefulness of accidental consequences monetarily, ranking alternatives on a single scale of preferences. The criterion is the expected value of utility, which is determined as follows (Vereshchaha et al., 2019):

$$Eu_{(a_i)} = \sum p_j \times u(x_{ij}), \quad (15)$$

where, Eu – expected utility; a_i – i-th alternative; x_{ij} – the result of the j-th result on the i-th alternative; p_j – the probability of the j-th result.

By inverting the utility function, the value is determined – the guaranteed equivalent (Vereshchaha et al., 2019):

$$CU = U^{-1}[U], \quad (16)$$

The value of the utility function for individual consequences x_1 and x_2 is marked by points A and B. The point D characterizes the usefulness of the expected value for both consequences, i.e.: $u(E(x)) = u(p_1 x_1 + p_2 x_2)$. The points on the line AB are a combination of the form: $a \times u(x_1) + (1-a) \times u(x_2)$, where $0 \le a \le 1$. At the point C this combination has the form $p_1 \times u(x_1) + p_2 \times u(x_2)$, i.e. the expected utility for both consequences (Eu) (Vereshchaha et al., 2019).

From the integral distribution function of random damage by differentiation by a variable value the function of its density, which allows to easily calculating the probability of occurrence of a value of damage is determined. To select the projected parameters of competitiveness of the meat-processing agricultural holdings, we assume that the variable is the years of research of insurance indicators and – the indicators themselves. Empirical dependences of variables that provide an approximation of actuarial calculations are presented in Table 2.

Thus, meat-processing agricultural holdings in the integrated system of economic relations with agricultural enterprises provides financial protection against risky consequences that lead to the loss of resources in the production and technological cycle and which has a probabilistic variable, which is determined and reimbursed after the occurrence of the insured event.

After the analysis and unification of risks in the competitive environment of the investigated 5 meat processing agricultural holdings, anti-crisis scenarios of their cross-industry interaction with agricultural enterprises were determined according to the indicators that best describe the parametric data of the level of competitiveness for the period 2024-2028 (Figure 11).

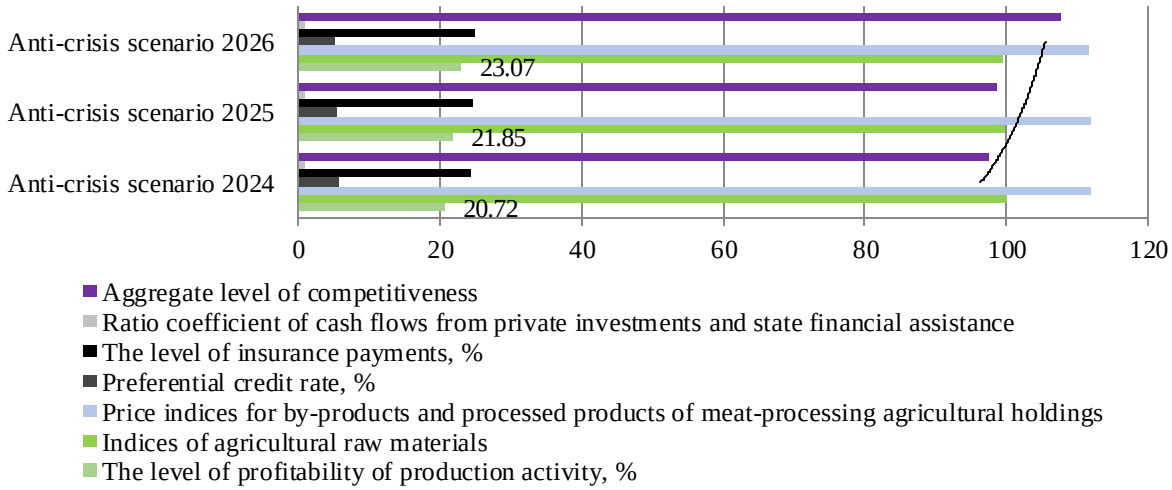

Figure 11. Anti-crisis scenarios of cross-industry interaction of meat-processing agroholdings in a holistic systemof economic relations with agricultural enterprises to neutralize crisis-factors of the competitiveness for 2024-2028

Source: compiled by the authors

Thus, the competitiveness of the processing industry depends on the effect of multifactorial risks of various modifications. The conditionality of their influence makes it possible to establish parametric limits for neutralizing the risks of production activities of agricultural enterprises in the future. The level of competitiveness of meat-processing agricultural holdings directly depends on their dynamic development, which is influenced by indices of agricultural raw materials, price indices for by-products and processed products, preferential credit rates, the volume of cash flows from private investments and state financial assistance, and the level of insurance payments. Protection against risks arising at the local level must be carried out according to the matrix of the indicative assessment of the production and technological cycle, which captures anti-crisis scenarios of inter-branch relations between the united enterprises of the processing industry according to clearly defined rules.

Table 2. Empirical dependences of variable indicators of insurance of the production and technological cycle of meat-processing agricultural holdings in approximation of actuarial calculations

Indicators	Calculation algorithm	Sum of squares of deviations	Direction of the curve
Forecasting the optimal parameters of insurance payments for meat-processing agricultural holdings in the integrated system of economic relations with agricultural enterprises			
Insurance payments, thousand USD	$y = 3797,6 - 342,091x$	18882.804	falls
	$y = e^{8,5692 - 0,272655x}$	24784.264	falls
Average payment for 1 contract, thousand USD	$y = -142,483x + 2086,454$	12269.262	falls
	$y = e^{7,6614 - 0,1728x}$	14061.873	falls
Average payment per 1 kg of products, USD	$y = e^{2,11873 - 0,29717x}$	60.16	falls
	$y = 6,0127 - 0,5762x$	48.79	falls
Average payment for 1 insurance company, thousand USD	$y = -23,362x + 279,247$	107725.51	falls
	$y = e^{5,85807 - 0,239884x}$	14163.064	falls
Forecasting the optimal parameters of sum insured for meat-processing agricultural holdings in the integrated system of economic relations with agricultural enterprises			
Total sum insured, thousand USD	$y = 270,811 - \frac{99,648}{x}$	66742.14	growth
	$y = e^{5,4627 - 0,006612x}$	74888.47	falls
Average sum insured for 1 contract, thousand USD	$y = 96,5426 + 51,1721 \cdot \ln x$	21553.16	growth
	$y = 87,773444 \cdot x^{0,406012}$	23999.27	growth
	$y = 227,67 - \frac{166,74}{x}$	19273.25	growth
	$y = e^{4,6481 + 0,07999x}$	27389.20	growth
Average sum insured per 1 kg of products, USD	$y = 422,666 - 14,206 \cdot x$	70464.51	falls
	$y = e^{6,033933 - 0,041933x}$	73110.38	falls
Average sum insured for 1 insurance company, billion USD	$y = 24,697 - \frac{13,563}{x}$	1198.46	growth
	$y = 16,987 + 2,47444 \cdot \ln x$	1377.20	growth
	$y = e^{2,845133 + 0,012848x}$	1347.25	growth
Forecasting the optimal parameters of insurance premium for meat-processing agricultural holdings in the integrated system of economic relations with agricultural enterprises			
Insurance premiums, billion USD	$y = -0,3304x + 9,44$	124.11	falls
	$y = e^{2,1068 - 0,033527x}$	147.34	falls
Average premium per 1 contract, thousand USD	$y = -0,34112 + 3,7236 \cdot \ln x$	73.37	growth
	$y = 3,1433023 \cdot x^{0,290529}$	42.50	growth
	$y = e^{1,29167 + 0,053151x}$	37.29	growth
Average premium per 1 kg of products, USD	$y = -0,6488x + 13,9287$	240.99	falls
	$y = e^{2,6043 - 0,063988x}$	249.77	falls
Average premium per 1 insurance company, billion USD	$y = 739,305 - \frac{322,816}{x}$	13623.015	growth
	$y = 614,543 + 20,001 \cdot \ln x$	14325.777	growth
	$y = e^{6,396267 - 0,013958x}$	14948. 937	falls

Source: compiled by the authors

4. Conclusion and Recommendations

Thus, anti-crisis scenarios of inter-sectoral interaction of agricultural market participants, which minimize the impact of production risks of agricultural enterprises, change indicators of the production and technological cycle and neutralize the crisis level of competitiveness of meat-processing agricultural holdings, are an important impetus for the formation of a strategic model for anti-crisis support of economic processes in the agro-food sector of the state economy.

It is on the basis of the basic criteria of risk neutralization and insurance, as well as the development of parameters of competitive advantages in the agricultural market, that marketing communication concepts can be developed, which allow the introduction of the export brand portfolio of processed products, with the maximum approximation of the standards of competitiveness of the processing industry to the absolute level. At the same time, only the modernization of the material, production, technological, fund-forming and financial subsystems of the competitiveness of the processing industry will ensure the high positions of the united subjects in the product market, and anti-crisis scenarios of inter-branch interaction will allow to reproduce the innovative development of the competitiveness of the united subjects of the processing industry in post-war period and reconstruct their system of economic relations with agricultural enterprises.

The restoration of lost competitive positions will draw the attention of private investors to changes in the fund-forming subsystem of the production and technological cycle and will ensure an increase in the share of investment resources in export-oriented processing products. That is, integrated anti-crisis scenarios of inter-sectoral interaction of agricultural market participants in an integrated economic system should be based on all components of the communication complex, which are interconnected by such elements as price, quality, cost, competitive potential, competitiveness of communication relations, competitiveness of the branding management system in the agricultural market.

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