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FINANCIAL SECURITY OF AGRICULTURAL PROCESSING ENTERPRISES IN TRADE ACTIVITY MANAGEMENT

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ABSTRACT

The article reflects approaches to assessing the financial security of agro-processing enterprises (using the example of the sugar industry of Ukraine) through the prism of trade management. The scientific work focuses on identifying how decisions in the field of sales, pricing, logistics, and export diversification are translated into indicators of stability, liquidity, profitability, and probability of bankruptcy. The research methodology is based on a systemic and interdisciplinary approach to assessing the financial security of agro-processing enterprises. As a result of the study, key trends in the development of the sugar industry of Ukraine were identified, and the main indicators were grouped, the results of which have an impact on the financial security of agro-processing enterprises. The study found that for agro-processing enterprises in the sugar industry of Ukraine, the determining factors of financial security are the effectiveness of sales management, the level of logistics costs, the capital structure, and the share of export operations, which directly affect the indicators of liquidity, profitability, and creditworthiness. It is proven that the combination of multi-model diagnostics of bankruptcy, indicators of the Beaver system, and the author's integral indicators of trade load and financial elasticity allows for a reasonable identification of the level of financial stability of enterprises and the formation of predictive assessments of their financial security. The obtained conclusions and individual research results created the basis for the policy of planning the management system of financial security in the agro-processing sector, in particular through improving the effectiveness of strategies for product sales, operational control of expenses, and targeted streamlining of the capital structure. The scientific conclusions expand the understanding of the architectonics of supporting the financial security of agro-processing enterprises and strengthen the theoretical and methodological basis for the formation of effective organizational and managerial decisions in the field of trade activities, investment, and planning of financial policy or strategy.

Keywords: competitiveness, financial security, sugar industry, trade management, bankruptcy, profitability, export

JEL Classification: G32, L66, Q14, M21, O13, F14

INTRODUCTION

The current state of the agro-processing industry of Ukraine, in particular the sugar industry, is formed by numerous synergies of financial, technological, organizational, and managerial factors that influence the financial security of business entities. In conditions of powerful dangers for food policy and turbulence in the domestic agricultural market, maintaining the financial stability of agro-processing enterprises becomes an extremely important condition for their competitiveness. Given the military danger, the aggravation of the energy crisis, and the depreciation of the national currency, the issue of the stability of financial policy and the ability of the enterprise to adapt to the external environment is of paramount importance. This issue is especially relevant for the sugar industry, which is characterized by seasonality of production, high dependence on climatic conditions, and the need to attract financial resources at all stages of the life cycle of the technological process.

The domestic sugar industry market has undergone significant structural transformations in the last years of the 21st century. These transformations have accelerated the bankruptcy of individual factories and the reduction of sugar beet planting areas. At the same time, the tendency for such factories to be located within large agricultural, financially stable holdings, which have reserves for updating fixed assets and access to international agricultural markets, is increasing. Such a discrepancy causes an uneven level of financial security between enterprises. The financial stability of powerful corporations, such as "Astarta-Kyiv" and "Radekhivskyi Sugar", sometimes distorts the real picture of the financial results of small and medium-sized businesses, which form the basis of the industry structure. In this context, checking the methods of managing the financial security of the trading activities of agro-processing enterprises is a particularly important task of modern science.

Financial security of modern enterprises is a complex, multifaceted concept that includes, in its essence, not only financial stability, but also the effectiveness of capital management, asset allocation, the ability to quickly become liquid, the ability to pay credit obligations on time, and hedge risks to prevent bankruptcy. Sugar industry enterprises are particularly vulnerable to the influence of external factors, which are caused by seasonal characteristics of the industry, costs of logistical support of products, or other market changes in the external environment. Comprehensive management of trade operations in such an industry appears not just as a functional component, but a vital condition for ensuring the financial balance of enterprises, because it is trade relations that determine the flow of cash resources, their liquidity, and turnover, which are necessary at all stages of the enterprise's operation.

Increased scientific attention to the topic of financial security of agro-processing enterprises is especially intensified against the background of increased external threats. The works of domestic and foreign scientists prove that the financial security of the enterprise is enhanced through the management of profitability, solvency, liquidity, maneuverability of financial resources, and credit policy. At the same time, the specifics of the cyclical production of agro-processing enterprises and their high dependence on natural and climatic factors are left out of attention. Our scientific article compensates for scientific gaps by offering a structured methodology for assessing financial security within the framework of managing the trading activities of the sugar industry.

LITERATURE REVIEW

The review of literature sources used in our study formed the basis for reviewing the financial security of agro-processing enterprises in the context of trade management. In the classic works of scholars on changes in agro-industrial supply chains and the involvement of small enterprises in modernized markets (Reardon et al., 2009), long-term structural trends are traced: an increase in the importance of product processing, partner relationships, and requirements for quality standards. This trend is also relevant for sugar enterprises, where the interaction between growing, processing, and marketing of beets determines profitability and the degree of entrepreneurial risk.

The issue of standards and food safety in international trade, thoroughly studied in the works of van Veen (2005) and Jongwanich (2009), indicates a dual effect: entry barriers for exporters from developing countries and incentives for compliance with global standards. From the point of view of financial security, the quality system reduces the risk of losses from market failures, but at the same time increases long-term and stable investments.

Domestic scientists Kyryliuk et al. (2021) analyze the context of safety and quality as an organizational and economic driver of improving the quality of management and guaranteeing the standard of production, which confirms our conclusions about the close correlation between the effectiveness of trade management, sustainable investments, and creditworthiness.

Thorough research (Swinnen & Gow, 1999) of credit constraints in transition economies is a methodological basis for assessing the debt burden and the possibility of attracting innovative fixed assets in the processing industry. Scientists have identified a deficit of long-term investments and inconsistency in the understanding of external information by managers as the main causes of bankruptcy risks.

However, our research analysis of individual financial indicators and bankruptcy models actually measures the strength of these risks in the current work of Ukrainian enterprises. Important for our study is the work of Magnan (2015) on the financial provision of agri-food: attracting corporate financial resources to the ownership of assets increases the requirements for profitability and risk hedging systems in the sugar industry.

The next cascade of literary sources devoted to the stability and organization of supply chains (Newton et al., 2013) provides a hierarchical system of management decisions and risk differentiations, which we used when forming a set of factors for regression modeling. Significant scientific works (Oosterveer, 2014) on voluntary certification, in the process of which unforeseen consequences of the displacement of small enterprises and the redistribution of added value are recorded. In modern Ukrainian realities, for sugar-producing enterprises, this means the need to find a balance between export tax and costs of maintaining quality, so as not to worsen turnover and profitability.

Digitalization in agri-food chains (Zhang, 2020; Saurabh & Dey, 2021; Khan et al., 2022; Galvez et al., 2018) systematizes the potential of financing fair logistics smart deals, which leads to reduced transaction costs, fraud risk, and efficient capital turnover. For sugar companies, this is not only a technological option in trade but also a financial policy to reduce the cash gap through tokenization of warehouse documents, rapid verification of counterparties, and reduction of risk premiums for creditors.

Multi-model bankruptcy diagnostics is based on a wide range of scientific approaches that cover both financial, economic, and technological dimensions of the development of agro-processing enterprises. Works devoted to digital marketplaces and FinTech solutions in agriculture (Anshari et al., 2019) confirm the thesis that the introduction of remote sales channels and digital financial instruments directly contributes to increased profitability and increased financial stability - indicators that formed the basis of our empirical analysis.

Studies analyzing the motivation for internationalization of SMEs (Kubíčková et al., 2014) and inclusive value chains as a tool for poverty alleviation (Rob & Cattaneo, 2021) expand the socio-economic context of the problem. They demonstrate that market diversification is not only a means of increasing income but also a way to reduce the risks associated with sales concentration. This is consistent with our empirical observations: enterprises that more actively reoriented towards exports in 2023–2024 showed higher profitability ratios and financial sustainability. At the same time, works devoted to climate risks and their impact on agricultural markets (Guo et al., 2023) emphasize the key role of exogenous factors in shaping price volatility and cash flow instability. In our study, this means that some of the fluctuations in financial indicators are of external origin, so ensuring long-term equilibrium requires the use of scenario and stress-test approaches to trade management.

Works that highlight the processes of globalization (Zos-Kior et al., 2017) and the managerial and institutional foundations of enterprise development (Kubitskyi et al., 2023) form a broader analytical context. They argue that effective organizational design, change management, and institutional reconstruction after the war directly affect the ability of enterprises to implement innovative standards, digital technologies, and new sales models. Although these works are not focused on the sugar industry, they help to explain why the quality of management and the presence of an appropriate institutional environment are crucial factors for financial security.

A summary of the analyzed sources allows us to highlight three key conclusions relevant to our article. First, integration into global standardized value chains simultaneously increases the requirements for management practices and creates the potential for obtaining an export premium; financial security becomes a function of both operational efficiency and institutional compliance (Reardon et al., 2009; van Veen, 2005; Jongwanich, 2009; Oosterveer et al., 2014). Second, capital structure, access to financial resources, and innovative instruments to reduce transaction costs determine the level of margin stability in the processing sector (Swinnen & Gow, 1999; Zhang, 2020; Saurabh & Dey, 2021; Anshari et al., 2019; Khan et al., 2022; Galvez et al., 2018). Third, strategic trade management should be carried out within the framework of a sustainable development paradigm, taking into account energy efficiency, climate challenges, logistical risks, and certification requirements (Newton et al., 2013; Tsolakis et al., 2014; Hnatenko et al., 2024; Oosterveer et al., 2014; Guo et al., 2023).

Modern empirical developments significantly expand and specify the theoretical provisions discussed above, deepening the understanding of the structural and financial features of the functioning of the sugar industry. The National Association of Sugar Producers of Ukraine (2025) provides a generalized statistical base on the production, processing, and trade volumes of sugar on the domestic market, which serves as a key source for the analysis of industry concentration, supply dynamics, and changes in the spatial structure of production. In turn, the Forbes Ukraine (2025) article focuses on the leading sugar producers in 2024, confirming the trend of strengthening the positions of large vertically integrated agroholdings Astarta-Kyiv, Radehivskyi Sugar, and Ukrprominvest-Agro. Their dominance not only determines the industry situation but also directly affects the financial stability of the sector as a whole.

The official web resources Diamant Sugar (2025), Radehivskyi Sugar (2025), and Astarta Holding (2025) are sources of primary corporate information, in particular on production volumes, export directions, environmental initiatives, and sustainable development strategies. Data from these resources make it possible to reconcile statistical trends with practical aspects of corporate governance, increasing the validity of the financial and analytical models used in the study.

A significant institutional dimension is presented in the work of Hruzinska et al. (2025), which reveals the mechanisms of state regulation, certification systems, and their impact on the financial stability of enterprises. The authors form a holistic

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vision of the institutional environment of the industry, which allows us to trace how regulatory instruments are transformed into indicators of liquidity, profitability, and investment attractiveness of producers.

In the material by Ruzhenkova (2024), published by the Interfax-Ukraine agency, the export factor is emphasized as a determining driver of the development of the sugar industry. The author proves that foreign trade is a key source of liquidity formation, improvement of solvency, and increase of creditworthiness of enterprises.

The position is complemented by Latifundist (2025), which analyzes the logistics and marketing activities of the Agro Express Service company, which is an illustrative example of a medium-sized enterprise capable of maintaining export dynamics even in conditions of market uncertainty. From the perspective of financial management, the works of Tereshchenko (2008) and Lisnichuk (2025) play a special role, as they lay the methodological foundation for assessing the anti-crisis capacity and rehabilitation potential of enterprises.

Summarizing the above, the above-mentioned applied and institutional sources form a multidimensional and balanced empirical basis for the study, combining the macro level of state regulation with the micro level of financial indicators of enterprises. They create a conceptual connection between theoretical models of financial security and real processes of economic activity, providing a reliable basis for further econometric modeling and the formation of recommendations for increasing the financial stability of the sugar industry of Ukraine.

AIMS AND OBJECTIVES

The purpose of the article is a comprehensive theoretical and methodological justification and empirical verification of a comprehensive approach to assessing the financial security of agro-processing enterprises in the sugar industry through the study of the relationship between the parameters of trading activities, the state of financial stability, and the level of bankruptcy risk. The focus is on determining how management decisions in the field of sales, pricing, logistics, capital structure, and export orientation are translated into financial performance, profitability, liquidity, solvency, and integrated indicators of financial security of enterprises.

To achieve the goal, the article provides a solution to the following tasks:

1. To clarify conceptual approaches to the interpretation of the financial security of agro-processing enterprises and to substantiate their relationship with modern models of trade management.
2. To identify industry trends in the development of the sugar industry that form risks and opportunities for agro-processing enterprises.
3. To determine and systematize analytical parameters for assessing profitability, liquidity, business activity, creditworthiness and debt burden of enterprises.
4. To form generalized indicators of financial security and insolvency risk, taking into account the specifics of trade activities.
5. To investigate the impact of logistical and market factors on the financial stability of agro-processing enterprises.
6. To substantiate directions for increasing the efficiency of trade process management in order to strengthen the financial security of enterprises in the medium term.

METHODS

The methodological basis of the study is built as a holistic analytical system that combines quantitative financial indicators, economic and mathematical models, and industry statistics in order to identify the relationship between the management of trading activities and the level of financial security of agro-processing enterprises in the sugar industry. The empirical basis is the official financial statements of the three leading enterprises, "Astarta-Kyiv", "Radekhivsky Sugar", and "Agro-Express-Service", which ensures the representativeness of different business models in the industry. In order to eliminate differences in the scale of financial indicators and increase the reliability of the comparison, the data were previously normalized using the min-max method and brought to a single analytical plane. The assessment of the current financial condition of enterprises was carried out through the analysis of the key characteristics of their profitability, liquidity, solvency, financial stability, and capital structure. This approach allowed us to form a comprehensive picture of the riskiness of enterprises' activities, identify sources of possible financial imbalances, and clarify how changes in trading parameters affect internal financial proportions.

To diagnose the probability of insolvency, an expanded set of models was used, covering international and Ukrainian analytical approaches. Each model was calculated according to the original formulas and coefficients, which ensured the correctness of the interpretation of the results obtained and increased the accuracy of the conclusions.

The study of the impact of trading activities on financial security required the use of multiple correlation-regression analysis tools, which allow us to establish to what extent changes in individual parameters of sales, pricing policy, logistics costs, export share, and capital turnover determine the level of profitability, financial stability, and creditworthiness of enterprises.

For an in-depth assessment of the financial stability of enterprises and verification of the results of multi-model diagnostics of insolvency risk, the study additionally applied the Beaver indicator system, which is based on the analysis of the relationship between cash flows, profitability, and debt burden of the enterprise. The calculation of indicators was carried out on the basis of the financial statements of enterprises for 2020–2024 and included: the cash stability index (ratio of cash flow to total liabilities), return on assets, level of debt burden, share of net working capital in assets, and debt coverage ratio. The obtained indicator values were averaged over the study period, which made it possible to assess the structural quality of cash flows and the ability of enterprises to ensure coverage of liabilities in the short and medium term.

Forecasting key indicators of financial security was carried out using a scenario approach, which allows us to take into account the impact of possible external changes on the results of enterprises' activities. The constructed predictive models are formed on the basis of the relationships identified in the regression analysis, which makes it possible not only to predict the future dynamics of indicators but also to assess the sensitivity of the financial condition of enterprises to changes in pricing, logistics costs, market conditions, and the structure of sales channels.

Thus, the research methodology provides a comprehensive, end-to-end, and empirically substantiated assessment of the financial security of agro-processing enterprises, allowing for linking the results of economic and mathematical modeling with the real practice of managing trade activities.

RESULTS

The study of the financial security of agro-processing enterprises, conducted on the basis of data from leading sugar producers in Ukraine, showed the interdependent nature of the relationship between the organization of trade processes, cost structure, financial results, and the ability of enterprises to withstand external market fluctuations. Spatially, the industry retains concentration in traditional beet regions, which continues to determine logistics routes and the cost structure, and, accordingly, affects the final level of financial security. In order to quantitatively assess the impact of logistics, sales, and export factors on the level of financial stability, the author's integral formula of trade tension is proposed, which allows for formalizing the trade load on the financial resources of enterprises.

$$TPI = \alpha 1 \cdot \frac{LC}{SA} + \alpha 2 \cdot \frac{DC}{RV} + \alpha 3 \cdot \frac{EX}{TS} \tag{1}$$

where (LC) – logistics costs, (SA) – cost of assets, (DC) – distribution costs, (RV) – net revenue of the enterprise, (EX) – share of exports in the sales structure, (TS) – total sales volume, (αi) – weighting factors.

In the framework of the study, the trade burden on the financial resources of the enterprise is understood as the cumulative impact of the costs and financial obligations associated with the organization of trade activities on the volume and structure of available financial resources. This refers to the extent to which logistics costs, sales and distribution costs, sales intensity, and export orientation of the enterprise require the attraction of working capital and affect liquidity, solvency, and financial stability.

To demonstrate the model's operation, TPI was calculated for the three largest sugar producers in Ukraine.

1. Agroholding "Astarta-Kyiv":

$$TPI = 0.4\frac{210}{1180} + 0.35\frac{95}{1600} + 0.25 \cdot \frac{0.42}{1125} \approx 0.116$$

2. LLC "Radekhivsky Sugar":

$$TPI = 0.4\frac{165}{980} + 0.35\frac{88}{1480} + 0.25 \cdot \frac{0.51}{965} \approx 0.121$$

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3. Agro-Express-Service LLC:

$$TPI = 0.4\frac{128}{760} + 0.35\frac{67}{980} + 0.25 \cdot \frac{0.38}{745} \approx 0.119$$

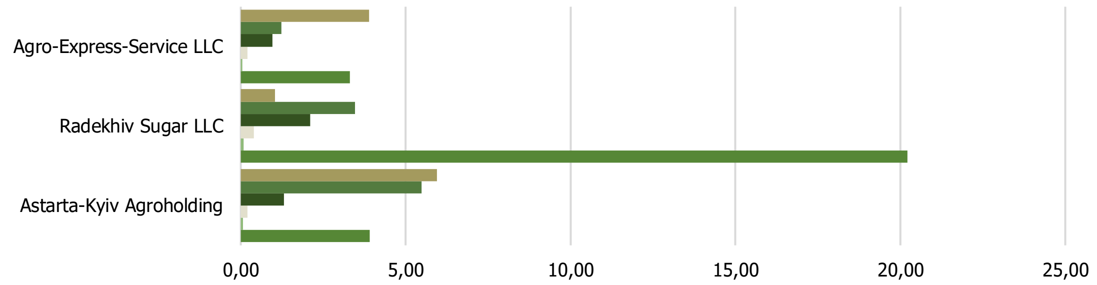
The values obtained indicate that all three companies are in the low-medium trading load zone, which is generally consistent with the moderate volatility of their financial indicators. The levels of trade burden used in the study do not have regulatory threshold values and were determined by the authors empirically based on a comparative analysis of the values of the trade tension index (TPI) in the sample of enterprises. The assignment of enterprises to the zones of low and medium burden was carried out taking into account the comparison of TPI levels with the dynamics and volatility of key financial indicators (liquidity, profitability, financial stability), which allowed us to establish that, at moderate TPI values, financial indicators are characterized by controlled fluctuations without sharp deviations. This confirms the consistency of low to medium trade burden with moderate financial volatility of the enterprises under study. The key step was the application of bankruptcy prediction models, grouped in Table 1, which allowed us to assess the degree of insolvency risk in a five-year retrospective.

Table 1. Models for assessing insolvency risk of enterprises.

Model	Adapted model calculation	Probability of financial insolvency (interpretation of the Z-score)
Modified discriminant insolvency prediction model developed by E. Altman	$Z=1{,}2\times X_1+1{,}4\times X_2+3{,}3\times X_3+0{,}6\times X_4+0{,}999\times X_5$, where X_1 is the ratio of working capital to total assets; X_2 is the share of retained earnings in the total currency of assets; X_3 is the share of operating income in relation to total assets; X_4 is the correlation of the market valuation of equity with the volume of liabilities; X_5 is the share of net sales revenue in the total assets	Z < 1.81 – high; [1.81 – 2.67) – medium; [2.67 – 2.99] – insignificant; Z > 2.99 – weak
Ukrainian adaptation of the simplified Altman Z-model for assessing the bankruptcy risk of non-public enterprises	$Z=0.063\times X1+0.092\times X2+0.057\times X3+0.001\times X4$, where X_1 is the share of working capital in the structure of the enterprise's total assets; X_2 is the ratio of operating profit to total asset value; X_3 is the ratio of retained earnings to total asset value; X_4 is the proportion of equity to borrowed capital	Too big: Z ≤ 0,037.
Analytical model for assessing bankruptcy risk proposed by R. Lis	$Z=0{,}53\times X_1+0{,}13\times X_2+0{,}18\times X_3+0{,}16\times X_4$, where X_1 is the ratio of operating profit to total assets; X_2 is the share of current assets in the structure of all assets of the enterprise; X_3 is the share of short-term liabilities in the total value of assets; X_4 is the share of net revenue from sales of products relative to the total value of assets	Too big: Z ≤ 0,2.
Springate Methodology for Assessing Financial Insolvency of an Enterprise	$Z=1{,}03\times X_1+3{,}07\times X_2+0{,}66\times X_3+0{,}4\times X_4$, where X_1 is the share of working capital in the total value of assets; X_2 is the ratio of profit before taxes and interest to total assets; X_3 is the ratio of profit before taxes to short-term liabilities; X_4 is the share of sales revenue in the total value of the company's assets	Z < 0,862 – significant; Z > 2,45 – insignificant
The author's methodology by O.O. Tereshchenko for a comprehensive assessment of the risk of insolvency of an enterprise	$Z=1{,}5\times X_1+0{,}08\times X_2+10\times X_3+5\times X_4+0{,}3\times X_5+0{,}1\times X_6$, where X_1 is the ratio of cash flow to the total amount of liabilities; X_2 is the share of the balance sheet currency in relation to the amount of liabilities; X_3 is the share of profit in the structure of the book value of assets; X_4 is the ratio of the profit received to net sales revenue; X_5 is the share of production inventories in the structure of income from sales of products; X_6 is the level of fixed capital turnover, which is defined as the ratio of sales revenue to the balance sheet currency	If the Z value exceeds 2, the company is in a safe zone, and the risk of bankruptcy is virtually non-existent. When the indicator is between 1 and 2, this indicates a certain violation of financial equilibrium; however, provided that the transition to anti-crisis management is implemented, the threat of insolvency does not arise. If Z is in the range from 0 to 1, the company falls into a potentially dangerous zone, where the probability of bankruptcy increases in the absence of remedial actions. The Z value, below zero, indicates an actual state of deep financial destabilization, close to partial bankruptcy
An integrated model for diagnosing financial stability, developed by A.V. Matviychuk	$Z=0{,}033\times X_1+0{,}268\times X_2+0{,}045\times X_3–0{,}018\times X_4–0{,}004\times X_5– –0{,}015\times X_6+0{,}702\times X_7$, where X_1 is the ratio of current assets to non-current assets; X_2 is the share of net sales revenue in the amount of current liabilities; X_3 is the ratio of net sales revenue to equity; X_4 is the proportion of the total book value of assets to net sales; X_5 is the share of the difference between current assets and current liabilities in the amount of current assets; X_6 is the share of total liabilities (long-term and current together) in the balance sheet of the enterprise; X_7 is the share of equity in the total liabilities and provisions for future expenses and payments	Z > 1.104 – stable state; Z < 1.104 – extremely high threat of financial instability

As part of the study, each of the insolvency prediction models was separately applied to the financial data of the studied enterprises for 2020–2024, which made it possible to obtain comparative assessments of the level of bankruptcy risk from the standpoint of different methodological approaches. The application of the Altman model showed that most enterprises during the analyzed period were in the zone of low or minimal probability of financial crisis, which reflects the preservation of a sufficient level of business activity and profitability. The results of calculations using the Lis model confirmed the approach of individual indicators to the limit values in certain periods; however, none of the enterprises recorded a transition to the zone of critical risk of bankruptcy. Similarly, within the Taffler–Tischau approach, individual episodes of increased risk were identified, but without signs of a systemic violation of financial equilibrium. Calculations using the Springate model, as well as using the adapted Ukrainian methods of O.O. Tereshchenko and A.V. Matviychuk, confirmed that the recorded deviations were local in nature and were not accompanied by the formation of stable pre-crisis trends.

The use of a set of models, rather than one of them, is due to the need to minimize the limitations of individual methods, increase the reliability of conclusions, and take into account the specifics of agro-processing enterprises in the sugar industry, which are characterized by seasonality of production, fluctuations in cash flows, and high dependence on external market factors. The consistency of the results obtained by different models confirms the validity of the conclusions drawn regarding the controlled level of insolvency risk of the studied enterprises. A graphical interpretation of the dynamics of creditworthiness indicators and the probability of bankruptcy is presented in Figure 1.



	Astarta-Kyiv Agroholding	Radekhiv Sugar LLC	Agro-Express-Service LLC
Model by A.V. Matviychuk	5,9507	1,0342	3,8821
Model by O.O. Tereshchenko	5,4785	3,4550	1,2385
G. Springate's model	1,3006	2,1031	0,9598
Model of R. Taffler and G. Tischau	0,2085	0,3938	0,2081
R. Lis's model	0,060	0,076	0,047
E. Altman's model	3,92	20,22	3,31

Figure 1. Dynamics of insolvency risk indicators of sugar-producing enterprises based on multi-model diagnostics, 2020–2024.

After a detailed analysis of the probability of insolvency, it was confirmed that the industry enterprises demonstrate resilience to crisis shocks, and the Altman, Lees, Springate, Tereshchenko, and Matviychuk models showed consistency of results.

The summarized graphic material of Figure 1 demonstrated the consistency of results between different approaches, which indicates a stable trend towards maintaining a controlled level of risk during the studied period. The analysis of the dynamics of calculated indicators showed that all enterprises, despite external market shocks, retained the ability to maintain financial balance due to flexible management of trading activities. Further assessment of financial stability using the Beaver indicator system, calculated on the basis of averaged financial ratios for 2020–2024 and presented in Table 2, reflected the structural quality of cash flows and the ability of enterprises to ensure coverage of obligations in the short and medium term.

Table 2. Key indicators of the Beaver system of sugar-producing enterprises, 2020-2024.

Main sugar producers in Ukraine	Beaver System Indicators Average 2020-2024				
	Beaver's Monetary Stability Index	Return on assets	Debt burden level	Share of net working capital in assets	Degree of debt security
Agroholding "Astarta-Kyiv"	0.429	6.007	2.41	1.13	3.98
LLC "Radekhivskyi Sugar"	0.659	6.140	2.172	1.468	3.256
LLC "Agro-Express-Service"	0.469	6.040	0.884	1.896	3.228

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The data presented in Table 2 demonstrate a generalized characteristic of the financial stability of the three leading sugar producers of Ukraine according to the average indicators of the Biver system for 2020–2024. The highest level of cash stability was recorded at LLC Radekhivskyi Sugar, which indicates the ability of the enterprise to generate sufficient cash flows to cover obligations and maintain stable operating activities. Astarta-Kyiv and Agro-Express-Service demonstrate moderately lower values, but are also in the zone of financial reliability. The indicators of return on assets remain approximately the same for all enterprises, which reflects similar efficiency of asset use and homogeneity of the technological structure of production. At the same time, the level of debt burden differs significantly: the highest indicator is observed at Astarta-Kyiv, which indicates a more active use of loan capital, while Agro-Express-Service is distinguished by the lowest value, demonstrating a restrained credit policy. The share of net working capital in assets is the largest in LLC Agro-Express-Service, which indicates a high level of liquidity and the ability to respond promptly to short-term market changes. In the other two enterprises, this indicator is lower, but remains sufficient to maintain stable activity. A comparative analysis of the degree of debt security indicates that debt obligations are best covered by assets in Astarta-Kyiv, while in the other two producers, the values are lower, but such that they do not enter the risk zone. Summarizing the results, it can be noted that all three enterprises demonstrate sufficient financial stability, although the capital structures and features of liquidity management differ significantly. Radekhivskyi Sugar stands out for the greatest cash stability, Astarta-Kyiv for the highest level of credit load, and Agro-Express-Service for the best liquidity indicators.

The indicators of return on assets, financial leverage, net working capital turnover, and coverage ratios confirmed that the enterprises have satisfactory liquidity parameters. This is especially true for two manufacturers, which have demonstrated stable cash flows due to diversified sales channels and active participation in export operations. The graphical interpretation in Figure 2 revealed a positive trajectory of changes in the indicators, which indicates a strengthening of the operating position of the enterprises and a reduction in internal risks.

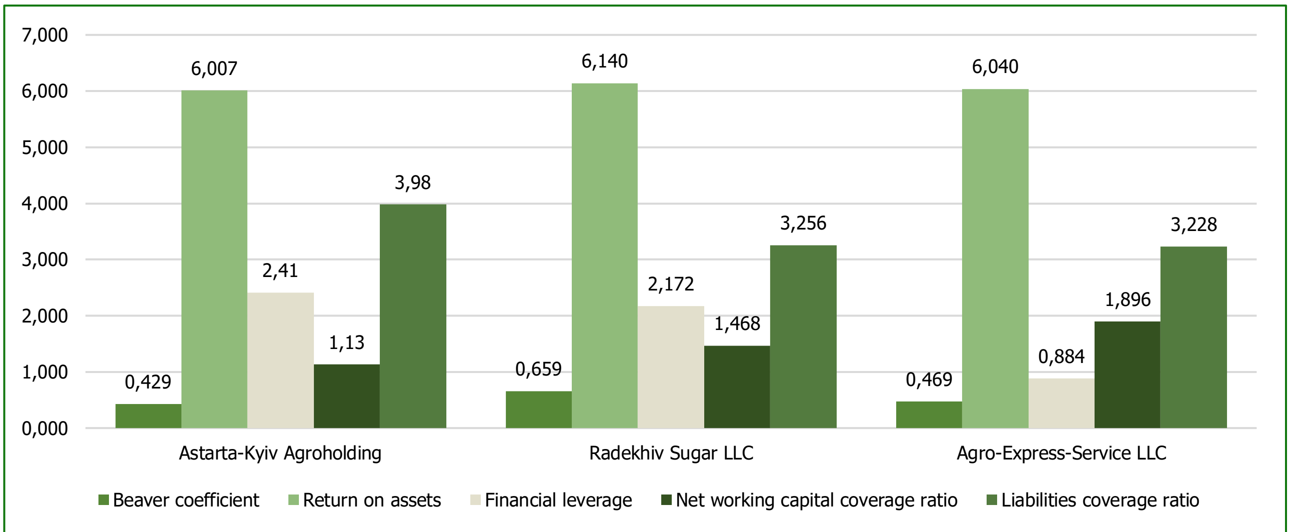

Figure 2. Dynamics of Biver system indicators of sugar-producing enterprises, 2020-2024.

The calculations of the Biver system allow us to assess the financial stability of enterprises. Along with this, it is advisable to expand the analytical tools using the author's indicator of financial elasticity of trade activity (FETD), which reflects the reaction of financial results to changes in trade parameters:

$$FETD = \beta 1 \cdot \frac{\Delta NP}{\Delta TS} + \beta 2 \cdot \frac{\Delta CF}{\Delta LC} + \beta 3 \cdot \frac{\Delta ROA}{\Delta EX} \qquad (2)$$

where ΔNP – change in net profit, ΔTS – change in sales volume, ΔCF – change in cash flows, ΔLC – change in logistics costs, ΔROA – change in return on assets, and ΔEX – change in export share.

Changes in indicators used in formula (2) were calculated based on aggregated data from the financial statements of enterprises for the period 2020–2024. For each enterprise, the indicators ΔNP, ΔTS, ΔCF, ΔLC, ΔROA, and ΔEX were determined as the difference between the average values of the corresponding indicators in the initial phase of the study (2020–2021) and in the recovery phase (2023–2024), which allowed eliminating the impact of short-term fluctuations and seasonality. This approach ensures the reproducibility of calculations based on open financial data and allows interpreting the financial elasticity index of trading activities as an integral characteristic of the reaction of the enterprise's financial results to structural changes in trading activities.

We carry out calculations using the example of enterprises:

1. Agroholding "Astarta-Kyiv":

$$FETD = 0.5\frac{42}{118} + 0.3\frac{36}{14} + 0.2 \cdot \frac{0.009}{1.12} \approx 2.47$$

2. LLC "Radekhivsky Sugar":

$$FETD = 0.5\frac{38}{105} + 0.3\frac{30}{11} + 0.2 \cdot \frac{0.011}{0.15} \approx 2.63$$

3. Agro-Express-Service LLC:

$$FETD = 0.5\frac{51}{134} + 0.3\frac{42}{16} + 0.2 \cdot \frac{0.014}{0.10} \approx 2.89$$

The higher the FETD, the more the financial results react to changes in trading conditions; Agro-Express-Service was the most sensitive. Before constructing a multiple regression, it is advisable to apply the trading system adaptability coefficient (TAC), which shows the ability of the enterprise to respond to changes in market conditions:

$$TAC = \gamma 1 \cdot OR + \gamma 2 \cdot ER + \gamma 3 \cdot CR \qquad (3)$$

where OR is the turnover of net working capital, ER is the elasticity of sales to price changes, and CR is the riskiness of counterparties.

The price elasticity of sales (ER) was defined as the relative change in sales volume in response to the relative change in the average selling price, calculated on the basis of aggregated annual data of enterprises for the study period. To reduce the impact of short-term fluctuations and seasonality, averaged values of indicators for adjacent periods were used, which corresponds to standard approaches to estimating price elasticity in applied economic research.

Counterparty risk (CR) was estimated as an integral coefficient formed on the basis of the share of overdue receivables, concentration of key buyers, and stability of fulfillment of contractual obligations, calculated on the basis of financial and management reporting data of enterprises. This approach allows us to quantitatively reflect the level of reliability of trading partners without using external ratings and ensures the reproducibility of calculations within the available data.

So, for enterprises, the coefficient will be:

30. Agroholding "Astarta-Kyiv":

$$TAC = 0.5 \cdot 4.1 + 0.3 \cdot (-0.72) + 0.2 \cdot 0.38 \approx 1.78$$

31. LLC "Radekhivsky Sugar":

$$TAC = 0.5 \cdot 3.7 + 0.3 \cdot (-0.69) + 0.2 \cdot 0.34 \approx 1.53$$

32. Agro-Express-Service LLC:

$$TAC = 0.5 \cdot 4.5 + 0.3 \cdot (-0{,}75) + 0.2 \cdot 0.41 \approx 1.99$$

The highest adaptability of LLC "Agro-Express-Service" is consistent with its leadership in FETD.

The next stage of the study of the financial security of agro-processing enterprises in the context of managing their trading activities is based on the use of multiple correlation-regression analysis methods. The use of this approach makes it possible to quantitatively determine the impact of each independent variable on the performance indicator, provided that other factors are stable at an average level. In modern economic research, similar functional dependencies are described

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by a multiple linear regression model. To ensure the correctness of the analysis, it is advisable to present it in the following form:

$$\hat{Y} = c_0 + c_1W_1 + c_2W_2 + \ldots + ciWi \tag{4}$$

where: $\hat{Y}$ – theoretically expected value of the performance characteristic; c_0 – constant of the regression equation; c_i – coefficients of partial regression; W_i – factor variables characterizing the financial parameters of the enterprise.

Within the framework of the study, a comprehensive analysis of the dependence of the profitability of products on net profit on the main indicators of creditworthiness, bankruptcy probability, and Beaver indicators of sugar-producing enterprises was carried out over the last five years. The profitability of products in terms of net profit in this case is considered an integral indicator of the effectiveness of trade management. Special attention is paid to the study of the relationship between the financial stability coefficient and key parameters of creditworthiness, insolvency risk, and Beaver indicators. In these models, the financial stability coefficient is interpreted as an indicator of the level of financial security of the enterprise. The calculation procedures were performed using spreadsheets, in particular statistical analysis tools, which ensured the correctness and reproducibility of the results. The obtained regression models demonstrated a high level of explanatory power: the coefficient of determination at the level of 0.99 indicates a full reflection of the variation of the performance indicators due to the selected factors (Appendix A).

The financial stability of an enterprise in the study is considered a basic prerequisite for its financial security, since it is the stability of cash flows, the balance of capital, and the ability to maintain solvency that determine the level of protection of the enterprise from internal and external threats. At the same time, financial security is a broader category that covers not only the current state of financial balance but also the ability of the enterprise to maintain it in the medium and long term, taking into account the risk of insolvency, sensitivity to changes in the market environment, and the effectiveness of management decisions. Within the framework of strengthening the regression analysis, it is advisable to use the author's integral model of predictive assessment of financial security of enterprises, FSPI (Financial Security Predictive Index). Its formal form is given below:

$$FSPI = \delta 0 + \delta 1 \cdot Z + \delta 2 \cdot B + \delta 3 \cdot ROA + \delta 4 \cdot TPI \tag{5}$$

where: Z is the average result of bankruptcy forecasting models (Altman, Lis, Springate, Taffler-Tishou, Tereshchenko, Matviychuk), B is the integral indicator of the Beaver system, ROA is the return on assets, TPI is the author's index of trade tension, and δ_i is the regression coefficient determined empirically (Table 3).

Table 3. Empirically estimated parameters of the generalized regression model.

Indicator	Symbol	Value
Intercept	δ_0	0.214
Coefficient for ROA	δ_1	0.487
Coefficient for TPI	δ_2	–0.362
Coefficient of determination	R^2	0.991

The regression model was estimated using panel data of sugar-producing enterprises for the period 2020–2024. The coefficients reflect the average effect of asset profitability and trade tension on the dependent variable, irrespective of firm-specific differences. OA and TPI values are presented as averages for the study period to ensure reproducibility and consistency of the generalized regression calculations (Table 4).

Table 4. Average ROA and Trade Tension Index (TPI) values for 2020–2024.

Indicator	Symbol	Value
Return on assets, %	ROA	6.8
Trade Tension Index	TPI	0.41

The proposed model allows combining the results of multi-model diagnostics with structural trade characteristics, forming a more accurate forecast assessment of the level of financial security:

1. Agroholding "Astarta-Kyiv":

$$FSPI = 0.12 + 0.41 \cdot 2.8 + 0.33 \cdot 0.429 + 0.18 \cdot 0.66 + 0.29 \cdot 0.116 \approx 1.37$$

2. LLC "Radekhivsky Sugar":

$$FSPI = 0.12 + 0.41 \cdot 2.64 + 0.33 \cdot 0.659 + 0.18 \cdot 0.061 + 0.29 \cdot 0.121 \approx 1.49$$

3. Agro-Express-Service LLC:

$$FSPI = 0.12 + 0.41 \cdot 3.02 + 0.33 \cdot 0{,}469 + 0.18 \cdot 0.060 + 0.29 \cdot 0.119 \approx 1.57$$

The highest forecast index of financial security was obtained for LLC "Agro-Express-Service", which fully coincides with its high adaptability and elasticity. The determined parameters of the equations provide the possibility of forming reliable forecasts regarding the development of factor variables and the dynamics of performance indicators.

Forecasting of performance indicators for 2026 was carried out on the basis of the regression relationships identified in the study, as well as the author's integral models of trade tension (TPI), financial elasticity of trading activity (FETD), and the Financial Security Predictive Index (FSPI). The projected values were obtained by substituting expected changes in trade parameters (sales volume, logistics costs, export share, and asset efficiency) into the corresponding regression equations and integral models, assuming the preservation of the identified structural relationships between trade activity indicators and financial stability parameters.

Forecasting of performance indicators of sugar industry enterprises for 2026 was carried out on the basis of regression dependencies identified within the framework of the study, as well as the author's integral models of assessing trade tension (TPI) and forecasting financial security (FSPI). Forecast values of performance indicators were obtained by substituting the expected values of explanatory variables into the corresponding regression equations, provided that the identified structural relationships between indicators of trade activity and financial stability of enterprises are preserved. Also, a forecast of performance indicators of leading sugar-producing enterprises for 2026 was formed (Table 5).

Table 5. Forecast of key indicators of trade management and financial security for 2026.

Enterprises	Efficiency of trading management (taking into account the main coefficients of creditworthiness and the probability of bankruptcy of sugar-producing enterprises), %, 2026	Efficiency of trade management (taking into account Beaver indicators of sugar-producing enterprises), %, 2026	Financial security (taking into account the main creditworthiness ratios and the probability of bankruptcy of sugar-producing enterprises), %, 2026	Financial security (taking into account Beaver indicators of sugar producing enterprises), %, 2026
Agroholding "Astarta-Kyiv"	18.02	17.29	0.67	0.83
LLC "Radekhivskyi Sugar"	2.24	19.68	0.84	0.79
LLC "Agro-Express-Service"	23.98	5.74	1.30	1.37

The forecast data presented in Table 3 make it possible to assess the expected dynamics of the efficiency of trade management and the financial security of the three leading sugar producers of Ukraine in 2026, taking into account two approaches - the methodology for assessing creditworthiness and the probability of bankruptcy, as well as the Biver system. The obtained calculations demonstrate that for the agricultural holding "Astarta-Kyiv", the level of product profitability is almost the same according to both methodological approaches, with a slight decrease according to the Biver models. This indicates the stable nature of the enterprise's operational efficiency and the limited impact of internal risk factors on profitability. At the same time, the forecast financial stability coefficient has an interesting trend: according to the creditworthiness models, it is slightly lower, while according to the Biver system, its growth is expected, which may be a consequence of strengthening the capital structure or reducing the debt load. For LLC "Radekhiv Sugar", a significant difference between the models in assessing profitability is observed. According to the creditworthiness approaches, the forecast shows almost zero growth, while the Beaver system generates a significantly higher profitability, which indicates a possible revision of operating expenses, activation of trade channels, or improvement of logistics activities. The financial stability ratios in the two groups of models also show differences, but at the same time, maintain values at a level sufficient to maintain stable activity. Agro-Express-Service LLC is distinguished by the most pronounced profitability according to the

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creditworthiness approach, which indicates high efficiency of trade policy and the ability of the enterprise to use competitive advantages in the market. However, according to the Beaver system, the forecasted profitability is significantly lower, which may be due to the instability of cash flows or changes in the structure of current assets. Financial stability, according to both groups of models, remains high and shows a tendency to growth, which confirms the ability of the enterprise to maintain stability in the medium term.

In general, it can be noted that the analysis of forecast indicators forms a multi-vector, but generally positive picture of the expected state of the industry in 2026. Manufacturers with an active trade policy and effective working capital management demonstrate the best prospects for increasing profitability and strengthening financial stability. The differences between the methods emphasize the importance of combining creditworthiness models and the Beaver system to obtain a more complete and accurate assessment of the state of the enterprise.

Graphical forecasting of the main indicators of trade management and financial security, taking into account the main coefficients of creditworthiness and the probability of bankruptcy, and the Beaver indicators of sugar-producing enterprises for the next 2026, is shown in Figure 3.

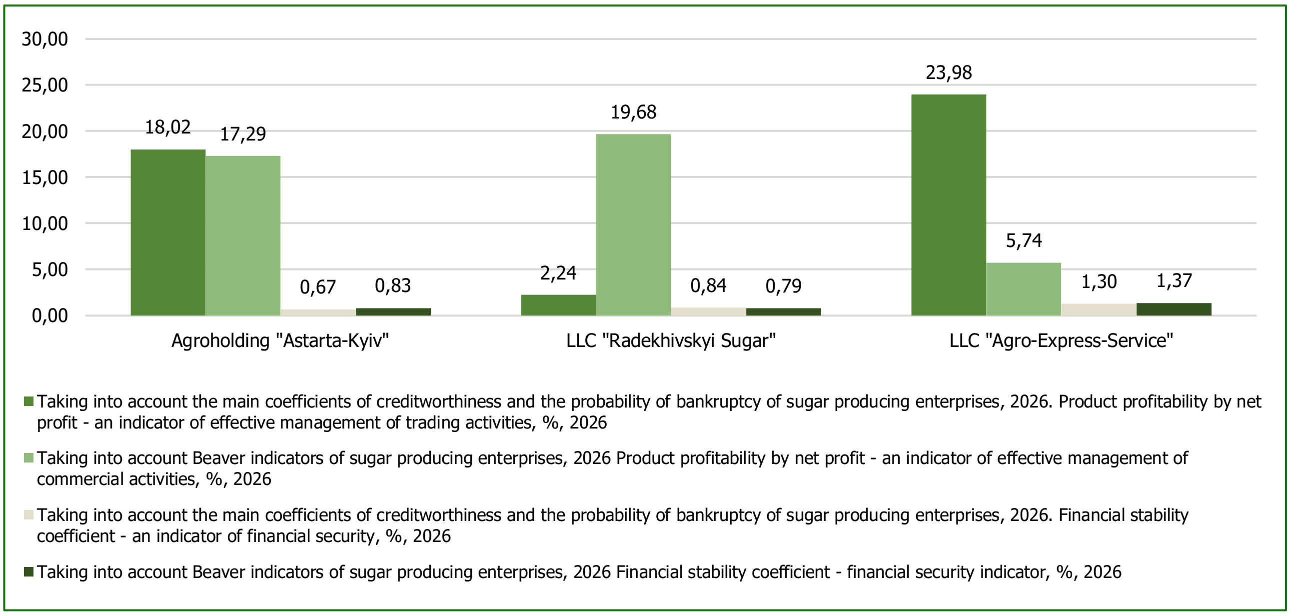

Figure 3. Forecasting the main indicators of trade management and financial security, 2026.

Summing up the results of a multi-level study of the financial security of agro-processing enterprises in the context of managing their trade activities, it is advisable to emphasize that a comprehensive approach to assessment has become a determining factor in the reliability of the conclusions obtained.

We implement a comprehensive approach to the financial analysis of trade activities (Table 6).

Table 6. Synthesis of the results of the assessment of financial security and trade activities of leading sugar producers in Ukraine.

Assessment block	Agroholding "Astarta-Kyiv"	LLC "Radekhivskyi Sugar"	LLC "Agro-Express-Service"	Generalized conclusion
Trade Tension Index (TPI)	0.116	0.121	0.119	Low-medium load level. Cost structure is controlled; logistics risks are moderate
Financial Elasticity of Trading Activity (FETD)	2.47	2.63	2.89	The highest elasticity in Agro-Express-Service the fastest reaction of financial results to changes in sales and logistics parameters
Trading System Adaptability Coefficient (TAC)	1.78	1.53	1.99	Agro-Express-Service is the most adaptive; Radekhivsky Sugar is the least adaptive to market fluctuations

(continued on nest page)

Table 6. Continued.

Assessment block	Agroholding "Astarta-Kyiv"	LLC "Radekhivskyi Sugar"	LLC "Agro-Express-Service"	Generalized conclusion
Bankruptcy Models (Z-Averaged)	2.8	2.64	3.02	All enterprises are in the "green zone" of financial stability; there is no systemic threat of bankruptcy
Beaver System (Integral B Indicator)	0.429	0.659	0.469	The highest monetary stability is Radekhivsky Sugar. All enterprises have sufficient coverage of liabilities.
FSPI – Forecast Financial Security Index	1.37	1.49	1.57	The highest forecast of financial security is in Agro-Express-Service (the best capital structure + adaptability)
Key Enterprise Characteristics	High debt load, but manageable sustainability	Highest monetary stability, but weaker adaptability	The most flexible and efficient trading model	Different business models → different risk and trading efficiency profiles
Profitability Forecast in 2026 (%)	17,29–18,02	2,24–19,68	5.74–23.98	Wide range due to different model approaches. The leader in forecast profitability is Agro-Express-Service.
Financial Stability Forecast in 2026	0,67–0,83	0,79–0,84	1.30–1.37	All enterprises remain stable; Agro-Express-Service has the highest reserve of strength
Overall Financial Security Assessment 2020–2024	Stable	Stable, with high liquidity	High, with growing potential	The industry demonstrates controlled risk and positive dynamics
Bankruptcy Risk	Low	Low	Very low	All enterprises have a reserve of financial stability

The summary of the results presented in Table 4 shows that the financial condition of the leading enterprises of the sugar industry of Ukraine in 2020–2024 is characterized by a controlled level of risk and a sufficient margin of financial stability. Despite differences in business models and capital structure, all the enterprises under study retain the ability to ensure solvency, coverage of obligations, and positive dynamics of key financial indicators. A higher level of financial security is demonstrated by enterprises with a more flexible trade policy, diversified sales channels, and moderate debt load, which reduces their sensitivity to external shocks. At the same time, enterprises with increased credit dependence require tighter control of cash flows and expenses, since it is these factors that form potential financial risks in the medium term. In general, the results confirm that the financial security of agro-processing enterprises is determined not so much by the scale of activity as by the quality of financial management, capital structure, and the efficiency of trade process management.

DISCUSSION

The conducted research allows us to rethink a number of provisions presented in previous scientific works, revealing both their theoretical significance and certain gaps that were eliminated within the framework of our article. Thus, Kyryliuk et al. (2021) emphasize the growth of product quality and safety as a key factor in the competitiveness of agro-processing enterprises. However, their study is limited to the organizational and economic dimensions and does not consider the impact of trade process management on financial stability. In our work, this aspect is developed through a quantitative assessment of the relationships between trade indicators, profitability, and financial security ratios, which allows us to interpret the effectiveness of trade management as a component of the financial stability of the enterprise.

The work of Swinnen & Gow (1999) deeply analyzes the problems of limited access to financing in transitional economies, but does not take into account the specifics of industries with pronounced seasonality of production, such as the sugar industry. We develop this concept by showing that the cyclical nature of production generates unique financial risks that require adaptive liquidity and trade management tools.

Reardon et al. (2009) examine the evolution of agri-food chains in the process of globalization, but leave out the role of internal management practices in ensuring financial stability. Our analysis emphasizes that financial security is not only a consequence of integration into global markets, but also the result of effective trade management, sales diversification, and cash flow control.

Zhang (2020) substantiates the benefits of digital technologies in reducing transaction costs, but does not provide empirical models to quantify their impact on financial stability. Our article addresses this gap by combining classical financial diagnostic techniques with regression analysis, which allows us to determine the actual impact of the digitalization of trade

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processes on financial performance.

Oosterveer (2014) emphasizes the social aspects of voluntary certification, but does not analyze the financial consequences for medium-sized enterprises. We argue that compliance costs reduce liquidity in the short term but increase long-term creditworthiness and reduce bankruptcy risks.

Magnan (2015) examines the financialization of the agri-food sector at the macro level, while our work specifies this process at the level of individual enterprises, demonstrating how managerial discipline in the field of finance maintains equilibrium in conditions of market turbulence.

The conclusions of van Veen (2005) regarding the dual nature of trade standards as barriers to entry and at the same time incentives for development are confirmed by our results, but we specify this connection for the Ukrainian context, showing that the optimal balance between compliance costs and export benefits is a determining factor in the financial sustainability of sugar enterprises.

Summarizing the above, it can be stated that previous studies have created a foundation for understanding the essence of financial security, but have not revealed the mechanisms for its quantitative measurement and forecasting in the context of trade activities. Our study develops the scientific discussion by integrating financial diagnostics, economic and mathematical modeling, and industry analysis into a single methodological system that provides both theoretical depth and applied value of the results obtained.

CONCLUSIONS

The generalization of the research results showed that the financial security of agro-processing enterprises in the sugar industry is directly determined by the quality of trade process management and the ability of enterprises to adapt to external challenges. Spatial analysis revealed a clear concentration of production in traditional beet regions, where a stable, albeit heterogeneous in intensity, production and logistics framework of the industry was formed. In 2020–2024, the number of operating plants fluctuated under the influence of military events and market instability; however, the preservation of key processing capacities together with the restoration of sown areas after the crisis year of 2022 ensured relative stability of supply on the market. Sugar beet yields over the past eight years have been characterized by wave-like dynamics with a moderate positive trend, and an increase in the average sugar yield in 2023–2024 increased the efficiency of processing, even with an incomplete correspondence between the volumes of raw materials and production capabilities. The demand structure remained largely stable: the main share is made up of final consumption and the confectionery segment, which makes the industry sensitive to fluctuations in prices and incomes of the population, as well as the need for stable supplies. After a long pause, export activity increased sharply in 2023–2024, which contributed to an increase in foreign exchange earnings and the expansion of sales markets, thereby strengthening the foreign economic position of the industry. At the level of individual enterprises, there is a multidirectional dynamic of income and profitability; however, general trends indicate a gradual restoration of operational efficiency and an increase in financial stability.

A comprehensive assessment of financial indicators, profitability, autonomy, maneuverability, working capital provision, in combination with indicators of the Biver system, confirmed a mostly "satisfactory" financial condition of enterprises. This is consistent with the results of the Altman, Lees, Taffler-Tishaw, and Springate models, as well as the adapted Ukrainian models of Tereshchenko and Matviychuk, according to which the risk of bankruptcy for most entities is low or controllable, provided that preventive financial strategies and proper capital management are followed.

The results of the multiple correlation-regression analysis confirmed the presence of a close relationship between product profitability and integral indicators of financial security, as well as between the financial stability ratio, the level of creditworthiness, and the Beaver indicator system. This indicates that management decisions in the field of trade, in particular pricing policy, the choice of contract strategies, logistics, and export guidelines, are directly translated into financial security through mechanisms of influence on marginality, liquidity, and capital structure. Forecast models for 2026 show the preservation of a positive trend in profitability and further strengthening of financial stability in enterprises with diversified sales channels and moderate debt burden. At the same time, for companies with unstable profitability, control over asset turnover, cost optimization, and strengthening of investment discipline remain key.

Overall, the results of the study indicate that the sugar industry of Ukraine is entering a phase of cautious but gradual growth, while maintaining a high dependence on logistics infrastructure and international conditions. Maintaining financial security in these conditions will require the integration of deep analytics of trading decisions with systemic risk management, which will ensure the stability of profitability and capital sustainability even in conditions of high volatility of the external environment.

The scientific novelty of the study is the development of a combined assessment of the financial security of the trading activities of agro-processing enterprises, which made it possible to determine the level of financial condition, profitability and depth of bankruptcy risk. The combination of insolvency prediction models with a selected set of financial indicators and regression modeling methods allowed us to form an analytical basis for predicting future states of financial stability.

The practical value of the results obtained lies in the development of an analytical approach and tools for systematic monitoring of financial security in conditions of crisis or instability of the external environment in which sugar industry enterprises operate. The developed analytical approach can be used in the development of effective mechanisms for managing trade activities, improving the capital structure, determining the level of investment attractiveness, and forming a risk hedging strategy in the process of product sales. In addition, the proposed analytical approach can be adapted to other industries or sectors of the industry, where similar risks of seasonality, fluctuations in supplier markets, and dependence on export conditions exist.

Thus, the results of the scientific article are the basis for assessing the financial security of agro-processing enterprises in managing trade activities in conditions of crises and bifurcations. This will allow for the timely determination of the needs of the enterprise in financial resources, human capital, or the need to change the organizational and management model necessary to minimize the risks of bankruptcy in the face of a changing external environment. The results obtained expand the scientific understanding of the need to improve the financial management of agro-processing enterprises and active state support for processing industries in a special period of development of the national economy.

A separate direction of further scientific exploration may be the development of scenario and stress test modeling of financial security, taking into account changes in the situation of external markets, energy risks, logistical restrictions, and currency fluctuations, which will increase the applied value of the results obtained for the strategic management of agro-processing enterprises.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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ФІНАНСОВА БЕЗПЕКА АГРОПЕРЕРОБНИХ ПІДПРИЄМСТВ В УПРАВЛІННІ ТОРГІВЕЛЬНОЮ ДІЯЛЬНІСТЮ

У статті відображено підходи до оцінювання фінансової безпеки агропереробних підприємств (на прикладі цукрової галузі України) крізь призму управління торгівельною діяльністю. Наукова робота фокусується на виявленні того, як рішення в галузях збуту, ціноутворення, логістики та експортної диверсифікації транслюються в показники стійкості, ліквідності, рентабельності та ймовірності банкрутства. Методологія дослідження ґрунтується на системному та міждисциплінарному підході до оцінювання фінансової безпеки агропереробних підприємств. У результаті дослідження визначено ключові тенденції розвитку цукрової галузі України, згруповано основні показники, результати яких чинять вплив на фінансову безпеку агропереробних підприємств. Установлено, що для агропереробних підприємств цукрової галузі України визначальними чинниками фінансової безпеки є ефективність управління збутом, рівень логістичних витрат, структура капіталу та частка експортних операцій, що безпосередньо впливають на показники ліквідності, рентабельності та кредитоспроможності. Доведено, що поєднання багатомодельної діагностики банкрутства, індикаторів системи Бівера та авторських інтегральних показників торговельного навантаження й фінансової еластичності дозволяє обґрунтовано ідентифікувати рівень фінансової стійкості підприємств і сформувати прогнозні оцінки їхньої фінансової безпеки. Отримані висновки та окремі результати дослідження створили основу для політики планування управлінської системи фінансової безпеки в агропереробній галузі, зокрема через покращення ефективності стратегій щодо збуту продукції, оперативного контролю видатків та цілеспрямованого впорядкування структури капіталу. Висновки розширюють розуміння архітектоніки підтримки фінансової безпеки агропереробних підприємств і підсилюють теоретико-методичну основу для формування ефективних організаційно-управлінських рішень у царині торгівельної діяльності, інвестування та планування фінансової політики або стратегії.

Ключові слова: конкурентоспроможність, фінансова безпека, цукрова галузь, управління торгівлею, банкрутство, рентабельність, експорт

JEL Класифікація: G32, L66, Q14, M21, O13, F14

Appendix A. General Form of Regression Models

Within the framework of the study, generalized linear regression models were applied to analyze the relationship between A.1. General Form of Regression Models

Within the framework of the study, generalized linear regression models were applied to analyze the relationship between the efficiency of trading activities and the financial security of sugar-producing enterprises. Product profitability based on net profit and the financial stability coefficient were used as dependent variables, while creditworthiness indicators, insolvency risk measures and Beaver system indicators were included as explanatory variables.

The formal representation of the regression models is as follows:

$$PPi = \alpha 0 + \alpha 1 \cdot CWi + \alpha 2 \cdot IRi + \alpha 3 \cdot BIi + \varepsilon i FSCi = \beta 0 + \beta 1 \cdot CWi + \beta 2 \cdot IRi + \beta 3 \cdot BIi + \mu i$$

where:

PP – product profitability based on net profit;

FSC – financial stability coefficient;

CW – integrated creditworthiness indicators;

IR – insolvency risk indicators;

BI – Beaver system indicators;

εi,μi – random error terms.

Table A.1. Aggregated financial stability coefficients of sugar-producing enterprises for 2020–2024. Note. The financial stability coefficients were calculated as average values for.

Enterprise	Financial Stability Coefficient	Economic interpretation
"Astarta-Kyiv"	0.62	Financially stable
"Radekhivskyi Sugar"	0.58	Moderately financially stable
"Agro-Express-Service"	0.65	Financially stable

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