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Assessment of risk management efficiency in furniture industry enterprises using econometric modeling: evidence from Uzbekistan

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Abstract. In recent years, furniture industry enterprises have faced increasing economic and financial risks driven by market volatility, cost fluctuations, and supply chain instability. These challenges are particularly relevant for emerging economies, where systematic risk management practices remain underdeveloped. This study aims to assess the efficiency of risk management in furniture industry enterprises in Uzbekistan using an integrated economic and econometric approach. The research is based on statistical and financial data. A set of key risk indicators is formed, and econometric modeling is applied to evaluate the relationship between risk management and enterprise performance. The results show that effective risk management significantly improves financial stability and operational efficiency of furniture enterprises. The proposed approach enables the identification of critical risk factors and supports forecasting of enterprise development under different risk conditions. The findings provide practical recommendations for improving risk management mechanisms in the furniture industry and contribute to empirical research on manufacturing enterprises in emerging economies.

INTRODUCTION

The furniture industry plays an important role in the development of manufacturing sectors by contributing to employment, value creation, and domestic market supply [1]. However, due to the complexity of production processes and supply chains, furniture industry enterprises are increasingly exposed to economic, financial, market, and operational risks [2]. These risks are intensified by global economic uncertainty, fluctuations in consumer demand, rising raw material prices, and supply chain disruptions, which directly affect production stability and competitiveness [3]. As a result, ensuring sustainable development of furniture industry enterprises requires the implementation of effective and systematic risk management mechanisms.

In emerging economies such as Uzbekistan, the furniture industry has demonstrated dynamic development driven by industrial modernization, increased investment activity, and growing domestic demand [4]. At the same time, enterprises in this sector face significant challenges related to financial instability, limited access to capital, and insufficiently developed risk management practices. In many cases, managerial decisions regarding risk mitigation are based on intuitive judgment rather than structured analytical tools and quantitative assessment methods, which reduces their overall effectiveness [5].

Existing scientific research on risk management mainly focuses on large industrial enterprises or on sectors such as energy, construction, and finance. Although various models for assessing economic and financial risks have been proposed, their application to furniture industry enterprises remains limited [6]. Moreover, a significant portion of previous studies relies on qualitative approaches, while the use of integrated econometric models to evaluate risk management efficiency is still underrepresented in the literature [7]. This gap is particularly evident in developing countries, where sector-specific empirical evidence remains scarce [8].

Several studies highlight the benefits of applying quantitative risk assessment techniques, including econometric modeling, to enhance decision-making and enterprise resilience [9]. These approaches allow for the identification of key risk factors, estimation of potential financial losses, and assessment of the impact of managerial interventions on

performance outcomes. In the context of the furniture industry, integrating financial, operational, and market indicators provides a comprehensive understanding of risk dynamics and supports strategic planning [10].

The relevance of this study is determined by the need to develop and apply quantitative methods for assessing risk management efficiency in furniture industry enterprises. An integrated approach that combines economic and financial risk indicators with econometric modeling allows not only the evaluation of current risk levels but also the identification of key factors influencing enterprise performance and financial stability [11]. Such an approach provides a more objective foundation for managerial decision-making and strategic planning.

The main objective of this paper is to assess the efficiency of risk management in furniture industry enterprises in Uzbekistan using a comprehensive risk assessment framework and econometric modeling. To achieve this objective, the study analyzes economic and financial indicators of furniture enterprises for the period 2019–2024, evaluates the impact of risk management on enterprise performance, and identifies priority directions for improving risk management mechanisms. The results of this research contribute empirical evidence to the existing literature and offer practical recommendations for enterprise managers and policymakers. The proposed methodological approach can also be adapted for other manufacturing sectors in emerging economies facing similar challenges.

EXPERIMENTAL RESEARCH

The assessment of risk in furniture manufacturing enterprises was carried out through the application of widely recognized corporate financial distress prediction models. Furniture enterprises possess unique operational and financial characteristics that influence their risk exposure, including diverse material usage (wood, MDF, metal, glass), complex technological processes, and specialized machinery requirements. These operational features, combined with sector-specific market volatility, create distinctive risk profiles that require tailored analytical approaches [12], [13].

To evaluate financial instability and potential bankruptcy, multiple multivariate discriminant models were employed. These models combine key financial ratios into composite scores, such as Z-scores or rating scores, providing a quantitative measure of an enterprise's financial health. Primary models applied in this research included the R. Taffler & G. Tishour four-factor Z score model, the M.A. Fedotov two-factor model, and the E. Altman five-factor Z score model specifically adapted for non-publicly traded firms. These models have been validated in previous research across different industrial sectors and are widely used in financial risk management studies [14].

The Taffler & Tishour model employs a four-factor discriminant function, separating financially stable firms from those at risk of distress. This model was originally optimized for industrial enterprises in the UK and has demonstrated robust predictive power when applied to manufacturing companies with complex operational structures [14]. The Altman Z score model, developed in 1968, remains a foundational framework in bankruptcy prediction research. It integrates financial ratios such as working capital to total assets, retained earnings to total assets, earnings before interest and taxes, leverage, and sales to produce a Z score indicating financial condition. Scores below established thresholds indicate heightened risk of financial distress [4]. The Fedotov two-factor model emphasizes solvency assessment through liquidity and leverage indicators, offering a simplified yet effective approach to early warning of financial instability.

In addition to traditional Z-score models, rating-based multivariate frameworks incorporating four to five financial coefficients were applied. These models generate a composite rating score reflecting liquidity, turnover, profitability, and solvency, allowing comparative analysis of enterprises' financial stability and operational risk exposure. The integration of these models enables cross-validation of results and provides a more comprehensive risk profile for furniture manufacturing firms.

The experimental procedure comprised several key steps:

1. Computing Z scores and rating scores for selected furniture enterprises using the formulas of the chosen models;
2. Comparing the computed scores against normative thresholds to classify firms into low, medium, and high-risk categories;
3. Analyzing the impact of specific operational factors—such as material diversity, production complexity, and capital intensity—on financial outcomes;
4. Conducting sensitivity analysis to assess the influence of changing market and financial conditions on risk scores;
5. Drawing empirical conclusions regarding the effectiveness of the applied models in predicting financial distress in the furniture sector.

This methodological approach provides a quantitative, evidence-based foundation for assessing risk management efficiency in furniture enterprises. Moreover, it bridges a significant gap in emerging economies, such as Uzbekistan, where empirical studies on sector-specific financial risks remain limited [15]. By applying internationally recognized models adapted to local industry conditions, the research contributes both to academic literature and practical managerial decision-making [16], [17], [18].

The results are summarized in 1 table, 2 table, and 3 table, which illustrate how each enterprise performed under the different model specifications.

According to the R. Taffler & G. Tishour four factor model, all analyzed enterprises scored above the normative minimum (0.3), indicating a lower probability of bankruptcy (1 table).

TABLE 1. Assessment of bankruptcy risk using foreign models

Enterprises	Taffler & Tishoun Four-Factor Model	Fedotov Model	Altman Five-Factor Model
Oqqin Furniture	$3.12 > 0.3$	$-1.73 < 0$	$1.21 < 1.23$
Davr-Durdona Furniture	$2.75 > 0.3$	$-16.79 < 0$	$0.65 < 1.23$
Mebel Mega Servis	$0.939 > 0.3$	$-2.24 < 0$	$2.55 > 1.23$

Results from the M.A. Fedotov model confirmed solvency across all firms analyzed. In contrast, the E. Altman five-factor model identified elevated bankruptcy risk for specific firms, highlighting the sensitivity of this model to profitability, liquidity, and leverage variations. [19]

TABLE 2. Rating-based financial analysis models and financial instability risk

Model / Indicator	Standard	Oqqin	Davr-Durdona	Mebel Mega Servis	Firdavs
Four-factor rating model (overall score)	1	5.57	2.91	4.30	1.20
Current liquidity ratio	≥ 2	0.65	6.81	18.55	1.55
Equity working capital ratio	≥ 0.1	2.45	0.41	0.34	-0.23
Working capital turnover	≥ 6	1.89	2.61	4.76	2.90
Equity profitability	≥ 0.2	0.32	0.75	0.76	1.17
Five-factor rating model (overall score)	1	4.38	2.45	5.01	0.95
Asset turnover ratio	≈ 2.5	0.34	1.27	3.81	1.01
Sales profitability	≈ 0.45	0.28	0.42	0.09	0.66

Rating-based analyses further refined the risk assessment. Through the four-factor rating model, current liquidity and proprietary turnover emerged as critical determinants of financial stability. The five-factor model incorporated additional indicators—such as asset turnover and product profitability—providing a more comprehensive view of enterprise risk exposure. [19]

TABLE 3. Impact of internal risk factors on financial instability of furniture enterprises

Risk Factors	Consequences of Risk Factors
Low level of production organization, equipment and technology	Deficit of own working capital
Decline in efficiency of resource utilization	High production cost, erosion of own capital
Excessive inventory accumulation	Decrease in capital turnover, increase in indebtedness
Attraction of debt capital under unfavorable conditions	Decrease in profitability and self-financing capability
Uncontrolled rapid expansion of activity	Increase in accounts receivable, need for short-term borrowing, creditor control
Weak marketing and customer relations	Decline in profit and sales profitability
Low wages and shortage of skilled labor	Lower labor productivity, reduced capital turnover, failure to achieve expected revenues

Internal risk factors—such as outdated technology, inefficient resource utilization, low working capital turnover, and insufficient managerial and marketing capabilities—were found to materially affect financial results and are detailed in 3-table. These internal dimensions, along with external environmental factors (e.g., input-price volatility and market demand shifts), collectively shape the financial risk landscape for furniture producers. [19]

The findings demonstrate that applying classical financial distress prediction models can yield actionable insights into the risk profiles of furniture manufacturing enterprises, even when adapting models developed in Western contexts to the emerging market conditions of Uzbekistan. Firms with weaker liquidity positions, higher leverage, or limited operational efficiency consistently exhibited higher risk scores. This justifies the need for targeted financial management strategies, enhanced internal control systems, and tailored risk mitigation frameworks for the furniture sector.

RESEARCH RESULTS

The furniture industry in Uzbekistan has experienced significant development over the past decade, influenced by multiple economic factors including production capacity, sales volume, enterprise risk levels, entrepreneurial activity, and per capita income. To analyze and forecast these dynamics, a multi-factor econometric modeling approach was employed using time series data from 2011–2022.

The analysis used key endogenous and exogenous variables identified through expert assessments and industry statistics. (Table 4) [20].

TABLE 4. Revenue and influencing factors in Uzbekistan's furniture industry (2011–2022)

Year	Revenue, bln. UZS (Y)	Average Furniture Production per Capita, thous. UZS (X1)	Furniture Sales Volume, bln. UZS (X2)	Average Enterprise Risk Coefficient, unit (X3)	Number of Entrepreneurial Entities (X4)	Per Capita Real Income, thous. UZS (X5)
2011	207.6	7.9	75.1	0.56	1085	2729.9
2012	228.0	9.7	85.7	0.65	1284	3267.8
2013	349.0	12.5	146.0	0.68	2134	3902.7
2014	491.4	16.2	341.0	0.72	2336	4472.0
2015	614.8	19.8	472.9	0.54	2385	5127.5
2016	1371.4	43.4	655.9	0.78	2508	5887.9
2017	1513.7	47.1	909.6	0.64	2615	6681.4
2018	1694.9	51.9	1261.4	0.75	2697	7767.0
2019	2299.1	69.1	1749.4	0.82	2925	9509.6
2020	2097.3	61.8	2426.1	0.69	3219	10734.2
2021	3059.8	88.5	3364.6	0.87	3336	13416.7
2022	3404.0	96.5	4666.2	0.85	3753	15979.3

To account for differing measurement units and trends, variables were logarithmically transformed, producing the model in table 5 [19]:

TABLE 5. Logarithmic transformation of variables (2011–2022)

Year	LnY	LnX1	LnX2	LnX3	LnX4	LnX5
2011	5.3	2.1	4.3	-0.6	7.0	7.9
2012	5.4	2.3	4.5	-0.4	7.2	8.1
2013	5.9	2.5	5.0	-0.4	7.7	8.3
2014	6.2	2.8	5.8	-0.3	7.8	8.4
2015	6.4	3.0	6.2	-0.6	7.8	8.5
2016	7.2	3.8	6.5	-0.2	7.8	8.7
2017	7.3	3.9	6.8	-0.4	7.9	8.8
2018	7.4	3.9	7.1	-0.3	7.9	9.0
2019	7.7	4.2	7.5	-0.2	8.0	9.2
2020	7.6	4.1	7.8	-0.4	8.1	9.3
2021	8.0	4.5	8.1	-0.1	8.1	9.5
2022	8.1	4.6	8.4	-0.2	8.2	9.7

The resulting multi-factor logarithmic regression equation was estimated in EViews:

$$\ln Y = 0.979 \cdot \ln X_1 + 0.057 \cdot \ln X_2 - 0.007 \cdot \ln X_3 + 0.309 \cdot \ln X_4 - 0.095 \cdot \ln X_5 + 1.52 \quad (1)$$

Exponentiating this equation yields the non-linear econometric model for revenue prediction:

$$Y_1 = \frac{X_1^{0.979} \cdot X_2^{0.057} \cdot X_4^{0.309} \cdot e^{1.52}}{X_3^{0.007} \cdot X_5^{0.095}} \quad (2)$$

Using the model and trends of the key factors, revenue and its determinants were forecasted for 2023–2027. The projections are summarized in table 6[19]:

TABLE 6. Forecast of revenue and key determinants in Uzbekistan's furniture industry (2023–2027)

Variable	2023	2024	2025	2026	2027
Revenue, bln. UZS (Y1)	3350.7	3682.3	4019.5	4361.0	4709.9
Average Production per Capita, thous. UZS (X1)	98.1	106.5	114.9	123.2	131.6
Sales Volume, bln. UZS (X2)	3746.9	4116.3	4485.6	4855.0	5224.3
Average Enterprise Risk Coefficient, unit (X3)	0.85	0.88	0.90	0.92	0.94
Number of Entrepreneurial Entities (X4)	3873	4081	4288	4496	4704
Per Capita Real Income, thous. UZS (X5)	14701.9	15816.6	16931.3	18046.0	19160.7

Figure 1 illustrates the revenue trend from 2011 to 2027, including the forecasted period [19].

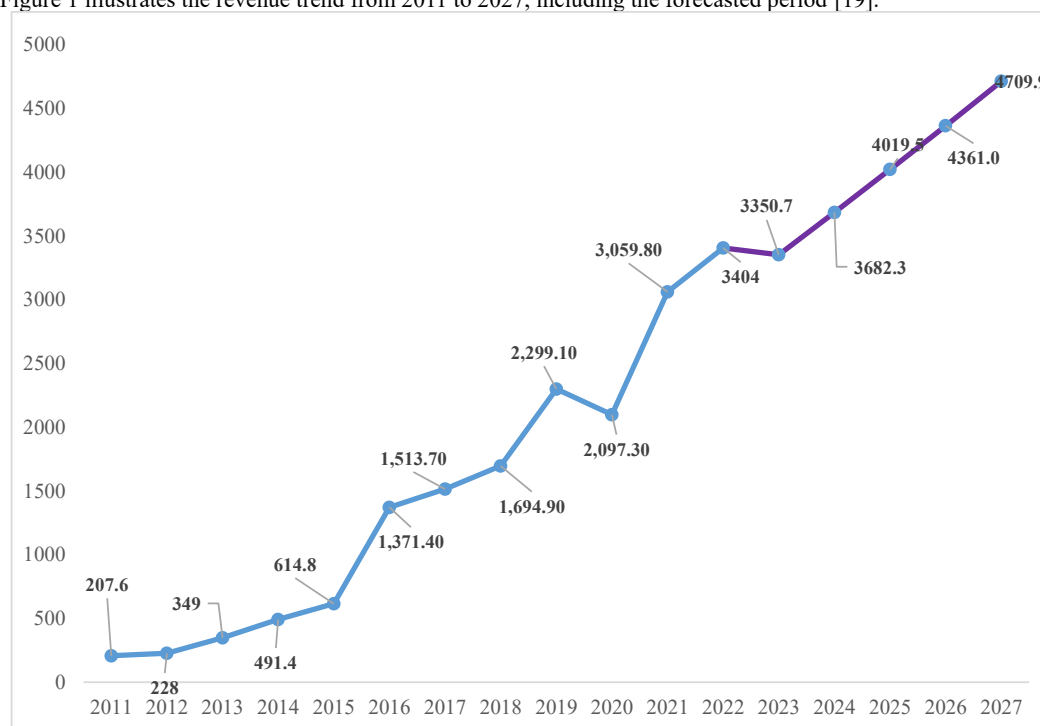


FIGURE 1. Revenue Growth in Uzbekistan's Furniture Industry, 2011–2027 (bln. UZS)

Note: Insert your plotted graph here, showing historical and forecasted revenue.

1. The multi-factor econometric model demonstrates a strong fit, capturing the relationship between revenue and key economic determinants.
2. The largest impact on revenue comes from per capita production volume (X1) and number of entrepreneurial entities (X4), consistent with industry expert evaluations.
3. The forecast indicates steady growth in the furniture sector, with revenue potentially reaching 4.7 trillion UZS by 2027 under current trends.

4. The model allows policymakers and industry stakeholders to optimize resource allocation, minimize risks, and implement proactive strategies to enhance sector growth.

This study presents a detailed econometric assessment of the furniture industry in Uzbekistan, focusing on the dynamics of enterprise revenue and production performance. Utilizing both linear logarithmic and nonlinear multiplicative models, the research identifies the quantitative impact of five critical explanatory variables: average per capita furniture production, total sales volume, average enterprise risk coefficient, the number of entrepreneurial entities, and per capita real income. The analysis demonstrates that production intensity and entrepreneurial engagement, supported by macroeconomic income levels, are the primary drivers of revenue growth, whereas enterprise risk and sales volumes contribute comparatively less to overall performance.

The constructed models provide robust predictive capabilities for historical data spanning 2011–2022, and the forecasts for 2023–2027 offer actionable insights for medium- and long-term sectoral planning. The findings emphasize the importance of strategic resource allocation, risk management, and targeted interventions to optimize industry outcomes. By integrating econometric modeling with expert evaluation, this research enables informed decision-making under conditions of uncertainty and market variability. These results not only facilitate effective enterprise management but also provide a foundation for policy development and investment planning, ensuring sustainable growth and enhanced competitiveness of Uzbekistan's furniture industry.

CONCLUSIONS

This study examined the development and revenue dynamics of the furniture industry in Uzbekistan using econometric modeling and trend analysis. The research identified key factors influencing industry performance, including per capita production, sales volume, average enterprise risk, number of business entities, and real per capita income. By applying a multi-factor logarithmic regression model, the study quantified the impact of these variables on revenue growth and generated forecasts for the period 2023–2027.

The results indicate that optimal allocation of resources, management of entrepreneurial activities, and consideration of market risks are critical for ensuring sustainable growth in the sector. The econometric model provides a reliable tool for policymakers and industry stakeholders to anticipate revenue trends and implement strategic decisions under conditions of uncertainty.

Furthermore, this analysis highlights the importance of integrating modern forecasting methods into industrial planning and management. Future research could expand the model by including additional macroeconomic and sector-specific variables or exploring non-linear and machine learning approaches to improve predictive accuracy. Overall, the findings contribute to a deeper understanding of the furniture industry's growth mechanisms and offer practical guidance for enhancing productivity and profitability in Uzbekistan's manufacturing sector.

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