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BANKRUPTCY RISK ASSESSMENT USING AN IMPROVED ALTMAN MODEL: A CASE STUDY ON TOYOTA CAR DEALERS IN ROMANIA

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Abstract
This study aims to analyse the applicability of the Altman model in assessing bankruptcy risk and in substantiating strategies for maintaining financial sustainability, using as a case study the network of 27 car dealers in Romania authorised to sell Toyota cars. Starting from the classic indicators of the Altman model, the model was improved by introducing a new financial indicator specific to the automotive industry, which captures the strategic role of inventories in the dealers' activity. Four multiple regression models were built and tested, and the comparative analysis highlighted the most statistically performing and most suitable model for forecasting. This improved model integrates all six financial indicators and reflects the economic realities of the car dealership sector, providing a basis for financial decision-making. The optimal strategy derived from the improved model includes: optimising working capital, increasing asset efficiency in generating sales, improving operational profitability, strengthening the capital structure, strategically managing inventories and maintaining a positive financial history. The study confirms the relevance of using the Altman model, adapted to the specificities of the Romanian car dealership market, as a tool to support decision-making and the development of proactive financial policies to ensure long-term stability and competitiveness.

Keywords: *Altman model; bankruptcy risk; financial sustainability; econometric model; optimal strategy.*

JEL Classification: *C51, M21, G33*

INTRODUCTION

In a macroeconomic environment marked by systemic disruptions and widespread volatility, the risk of bankruptcy has different implications for the dynamics of the automotive industry, both nationally and globally. This industry, defined by capital intensity, advanced technological integration and strong dependence on global value chains, becomes affected by increased financial risks during periods of economic instability. Inflationary instability, successive increases in monetary policy interest rates, trade imbalances and logistical bottlenecks caused by exogenous factors (such as the conflict in Ukraine or the global semiconductor crisis) are disproportionately affecting manufacturers and suppliers in the automotive sector. In this general context of pressure, companies with high levels of debt, narrow operating margins or increased rigidity in adapting their operational flows are facing an increased likelihood of insolvency or forced restructuring. In this context, assessing the risk of bankruptcy becomes not only an analytical exercise with accounting value, but also a strategic exercise to anticipate structural vulnerabilities and design intervention scenarios. Financial prediction models, including the one proposed by Edward Altman, which remains one of the most widely used, allow risk to be quantified through a synthesis of key performance indicators: liquidity, profitability, asset utilisation efficiency, solvency and revenue dynamics.

In this study, we aim to analyze, in a clear manner and adapted to the current context, the risk of bankruptcy associated with the network of car dealers operating under the Toyota brand in Romania, in direct correlation with the economic and financial factors that characterise the recent period, marked by macroeconomic instability and structural pressures on the automotive sector. Given the strategic position of these entities in the distribution value chain and their direct relationship with the dynamics of the automotive market, the analysis focuses on assessing the financial vulnerabilities of dealers using key indicators such as X_1 is "Working capital / Total assets", X_2 is "Retained profits/ Total assets", X_3 is "Earnings before interest and taxes (EBIT) / Total assets", X_4 is "Market value of equity / Carrying amount of total liabilities", X_5 is "Sales / Total assets" and X_6 is Inventories / Total assets. Also in this sense, we propose to apply bankruptcy risk prediction models validated in the specialized

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literature, the Altman Z-Score model (Altman, 1968), to identify potential financial imbalances that may threaten the short- and medium-term viability of the Toyota distribution network in Romania. Romanian economic instability, reflected in persistent inflation, rising borrowing costs, declining consumer appetite and currency fluctuations, is putting direct pressure on turnover, profit margins and inventory turnover. In summary, the analysis of the risk of bankruptcy within the Toyota dealer network is not limited to an accounting exercise of interpreting indicators, but becomes a strategic approach to anticipating weaknesses in an economic segment that is sensitive to cyclical changes and disruptive forces in the field of mobility, digitalisation and the transition to low-emission vehicles. We believe that the results obtained in this study can serve as a basis for both corrective measures at the operational level and commercial policies adapted to the new economic realities.

I. LITERATURE REVIEW

The risk of bankruptcy is a multidimensional issue, the manifestation of which is influenced by a set of interdependent factors, including the individual financial performance of the economic entity, volatility and competition in the market environment, but also the pressure exerted by fixed or recurring costs, including those associated with social obligations (Horváthová & Mokrišová, 2018). In this conceptual framework, according to Settembre-Blundo et al. (2021), Malynovska, et al. (2025), bankruptcy risk cannot be interpreted solely as an accounting imbalance but, in current economic debates, is considered a central dimension of business model sustainability and operational flexibility in the face of external shocks and global uncertainties.

An important aspect of bankruptcy risk is the financial indicators and models used to predict bankruptcy. Numerous studies emphasise that traditional financial indicators and models, such as Altman's Z-score (Altman, 1968) and its modified variants, are relevant for assessing bankruptcy risk in various industrial sectors. The effectiveness of the model has been confirmed and refined by numerous empirical analyses. For example, in their study, C.Y. Pratiwi and S.N. Harahap showed that Altman's score, the Z-score, remains an effective standard method for predicting bankruptcy, but that accuracy can be improved by integrating a machine learning approach (Pratiwi & Harahap, 2024). This hybridisation represents an evolutionary step, as machine learning technologies, through the processing of large data sets, are able to extract complex patterns that cannot be recognised by traditional statistical methods with greater accuracy (Altman et al., 2016). Kozel et al. (2022) demonstrated that the modified Altman model is particularly effective in predicting the bankruptcy of mining companies in the Baltic region. The use of the Altman Z-score in countries with economic difficulties, such as Greece (Mantziaris-Zafeiris, 2015; Georgios & Georgios, 2023; Toudas et al., 2024), demonstrates its adaptability to different economic environments and its support for risk-based decision-making for a wide range of stakeholders, from investors to management. This model has also been tested in Malaysia and Indonesia, where researchers have been able to effectively predict bankruptcies and promote better corporate governance (Lassoued, 2018; Pernamasari et al., 2019; Azhar et al., 2021).

Similarly, Prusak's (2018) study highlights the evolution of bankruptcy prediction models in Central and Eastern Europe and emphasises the historical context of the need for such research. Papakyriakou et al. (2018) in their research, they study the impact of financial company bankruptcies on investors and market behavior, confirming the link between economic factors and bankruptcy risk prediction. In addition to financial performance, qualitative factors play a role in determining bankruptcy risk. The inability of companies to manage their profits and their strategic position significantly increases the risk of bankruptcy (Agustia et al., 2020; Dalwai & Salehi, 2021). Jannah and Purnomosidi (2021) consider that interactions between business strategy, risk management framework, and bankruptcy risk are effective management strategies that can reduce these risks. These findings are important for organizations/companies operating in a complex financial environment. Furthermore, we believe that understanding bankruptcy risk is closely linked to broader economic trends and investor behavior. For example, Christiawan and Kwistianus (2023) emphasise that market reactions to bankruptcy risk differ between distressed and stable companies, suggesting that, during periods of financial crisis, investors' perceptions of the market directly influence company value. This is consistent with Md-Rus's (2011) finding that bankruptcy risk is a systemic risk that affects stock returns and can influence companies' financing strategy and investment decisions. The Altman model has also been studied and improved in the insurance sector in various countries, where it is used to assess financial risk or financial performance (Rahman et al., 2022; Yuliadi & Fitranita, 2024; Macovei et al., 2024).

In conclusion, we consider that the risk of bankruptcy is determined by a number of interconnected factors, such as financial performance, business strategy, individual pressures on decision-makers and general market trends. Recognising the complexity of bankruptcy risk is important for companies to take early action to ensure their financial stability and enable them to maintain their long-term sustainability.

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II. MODELLING METHODOLOGY

The Altman Z-score model was introduced in the second half of the 1960s and has since played an important role in bankruptcy prediction. This review of the literature integrates several studies that present the theoretical background of the model, examples of its application and its effectiveness in different industries and situations, highlighting its enduring importance in financial analysis and corporate management. Altman's model uses a multivariate approach based on five financial indicators to assess the bankruptcy risk of companies (Asif et al., 2024). This model was originally developed for listed companies, but has since become applicable to unlisted companies and different industrial sectors.

Table 1. Definition of the Z-score according to Altman:

Z-score model	Z interval	Interpretation
$Z = 1.2 * X_1 + 1.4 * X_2 + 3.3 * X_3 + 0.6 * X_4 + 1.0 * X_5$	Z > 2.99	Safe zone
	1.81 ≤ Z ≤ 2.99	Grey zone
	Z < 1.81	Danger zone
$Z = 0.717 * X_1 + 0.847 * X_2 + 3.107 * X_3 + 0.420 * X_4 + + 0.998 * X_5$	Z > 2.9	Safe zone
	1.23 ≤ Z ≤ 2.9	Grey zone
	Z < 1.23	Danger zone
$Z = 6.56 * X_1 + 3.26 * X_2 + 6.72 * X_3 + 1.05 * X_4$	Z > 2.6	Safe zone
	1.1 ≤ Z ≤ 2.6	Grey zone
	Z < 1.1	Danger zone

where: X_1 is "Working capital / Total assets", X_2 is "Retained profits/ Total assets", X_3 is "Earnings before interest and taxes (EBIT) / Total assets", X_4 is "Market value of equity / Carrying amount of total liabilities", X_5 is "Sales / Total assets".

Source: Author's elaboration based on (Asif et al., 2024), (Utami & Kawulur, 2020)

Therefore, according to the Altman model, the Z-score allows companies to be classified into three categories: the safe zone, indicating financial stability and low risk of bankruptcy; the grey zone, associated with an uncertain level of risk; and the danger zone, signalling a high risk of insolvency and the need for urgent corrective measures.

Over the years, numerous studies have confirmed the reliability and predictive power of the model, and its application has been reported in various industries and countries/regions. For example, Kazemian et al. (2017) demonstrated that a higher net profit margin is positively correlated with the Z-score and reduces the risk of financial crisis. Similarly, Muñoz-Izquierdo et al. (2019) have demonstrated that the accuracy of Altman's model improves when data from external audit reports are also taken into account. Combining prediction models based on artificial intelligence techniques with information extracted from external audit reports improves bankruptcy predictions (Muñoz-Izquierdo et al., 2019). In addition, recent research attempts to apply the Altman model in a specific context, such as the changes in the hotel industry during the COVID-19 pandemic (Pemo et al., 2024), where the indicators could be used effectively to predict bankruptcy risk (Matejić et al., 2022; Špiler et al., 2022). There are studies on the Islamic banking sector in Indonesia (Shafitranata & Arshed, 2020; Utama & Hamidah, 2024; Rafiqi et al., 2025), where a comparative analysis was conducted between the Altman model and alternative models, such as the Springate model. Analysing different studies, differences in prediction models can be observed, but the fundamental importance of the Altman model in predicting bankruptcy is reconfirmed. Researchers N. Younas, S. UdDin, T. Awan, and M.Y. Khan (2021), A. Sareen and S. Sharma (2022) demonstrated the usefulness of the Altman Z-score in assessing financial crises in various sectors, confirming the applicability of the model in emerging markets. According to other researchers, S. Ray (2011), H. Platt and M. Platt (2013), A. Rahman (2022), M. Svítil and I. Svoboda (2024), the Altman Z-Score model has proven to be a useful tool for predicting bankruptcy in the automotive industry.

In this study, we aim to determine the applicability of the Altman Z-Score model in the automotive sales sector in Romania and, in particular, in the case of car dealership networks, whose financial characteristics differ significantly from those of the industrial companies for which the model was originally designed. Starting from the structure of the classic model, we propose for analysis a generalised form, to which we add a new indicator that is important for the specific nature of the automotive sector: the share of inventories in total assets. In the car dealership business, vehicle inventories are a major component of current assets and influence both the liquidity and financial exposure of the company. We believe that tying up capital in inventories that are difficult to sell is a risk factor with a direct impact on the sustainability of the company. Thus, the model we propose in this study is:

$$Z_{\text{auto}} = \alpha + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + \beta_5 * X_5 + \beta_6 * X_6$$

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where: X_1 is "Working capital / Total assets", X_2 is "Retained profits/ Total assets", X_3 is "Earnings before interest and taxes (EBIT) / Total assets", X_4 is "Market value of equity / Carrying amount of total liabilities", X_5 is "Sales / Total assets".

In addition to the classic indicators used in the Altman model, we have included a new indicator in the proposed model, X_6 which is Inventories / Total assets, considered relevant by the authors for the specific case analysed, in which the high share of motor vehicle inventories in total assets can significantly influence liquidity and, implicitly, the risk of bankruptcy.

The network analysed in the study consists of 27 car dealers operating in Romania, which sell Toyota cars. They operate through a series of sales outlets distributed nationwide, reflecting the brand's extensive geographical presence on the Romanian market. The distribution of these dealers is illustrated in the figure below:

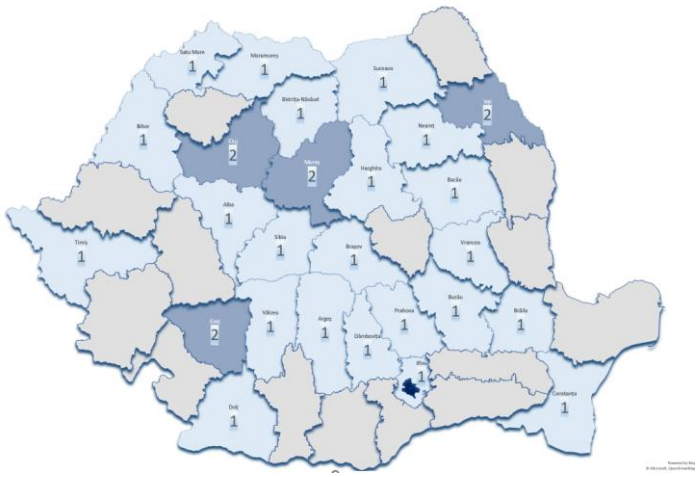

Figure 1. Map of Toyota car dealers in Romania
Source: Prepared by the author based on the Toyota Romania database (https://www.toyota.ro/)

The data used comes from the TopFirme platform (https://www.topfirme.com/), which provides information on financial indicators relevant to companies in Romania, including car dealers. In order to support the relevance of the bankruptcy risk assessment model for the automotive dealership sector, we analysed the correlations between the main financial indicators included in the Z_{auto} model. The correlation matrix is presented in the table below:

Table 1. Correlation matrix

		Z_{auto}	X_1	X_2	X_3	X_4	X_5	X_6
Pearson Correlation	Z_{auto}	1.000	.340	.402	.453	.182	.420	.194
	X_1	.340	1,000	-.150	.124	.129	-.389	-.487
	X_2	.402	-.150	1	.761	.034	.554	.370
	X_3	.453	.124	.761	1,000	.044	.326	.227
	X_4	.182	.129	.034	.044	1,000	-.042	-.063
	X_5	.420	-.389	.554	.326	-.042	1	.600
	X_6	.194	-.487	.370	.227	-.063	.600	1
Sig. (1-tailed)	Z_{auto}	.	.000	.000	.000	.000	.000	.000
	X_1	.000	.	.002	.007	.006	.000	.000
	X_2	.000	.002	.	.000	.255	.000	.000
	X_3	.000	.007	.000	.	.195	.000	.000
	X_4	.000	.006	.255	.195	.	.207	.109
	X_5	.000	.000	.000	.000	.207	.	.000
	X_6	.000	.000	.000	.000	.109	.000	.

Source: Authors Computation with the aid of IBM SPSS Statistics, version 26

Although the correlation coefficients calculated between the six indicators included in the Z_{auto} model and the resulting composite score do not indicate a strong link in statistical terms, the presence of weak but significant correlations reflects an important structural reality in the financial analysis of Toyota car dealers. In a sector characterised by low profit margins, high seasonality and exposure to external factors (such as the manufacturer's commercial policies or demand volatility), financial variables tend to evolve asymmetrically and often compensatorily. As we know, Toyota has a strategy of achieving low profit margins in order to generate high sales volumes. We believe that this policy has a positive impact on Toyota dealers' profitability, through increased car turnover and stable demand, but at the same time exposes the company to financial risks during difficult economic

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periods. Looking at Table 1, we can see that the highest correlation is between Z_{auto} and X_3, at 0.453, which indicates a moderate positive correlation. Therefore, in the economic context of car dealers in Romania, operating profitability plays a significant but not decisive role in determining bankruptcy risk. Other moderate correlations are between Z_{auto} and X_5 , with a value of 0.420, suggesting the efficiency of asset utilisation in generating revenue, and between Z_{auto} and X_2 , with a value of 0.402, reflecting the profitability accumulated over time.

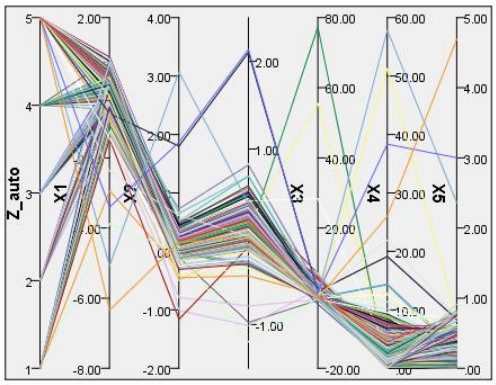

Figure 2. Graph
Source: Authors Computation with the aid of IBM SPSS Statistics, version 26

Therefore, based on the results obtained in the correlation analysis and confirmed by Figure 2, we observe the existence of weak to moderate links between the composite score Z_{auto} and each of the financial indicators considered. Although not very strong, these relationships are economically significant and justify continuing the analysis with a quantitative modelling stage. In this regard, we formulate the following research hypotheses, which will form the basis for testing the relationships between variables within the proposed model:
H1: Working capital relative to total assets (X_1) shows a positive trend over the period analysed and is associated with a higher Z_{auto} score, indicating better liquidity and a lower risk of bankruptcy for Toyota car dealers in Romania;
H2: Accumulated profitability (X_2) shows a positive correlation with the Z_{auto} score of Toyota car dealers with constant reported profits being more financially sustainable;
H3: Operating profitability (X_3) has a significant positive impact on the Z_{auto} score of Toyota car dealers in Romania, reflecting their ability to generate income from their current activity;
H4: The higher the ratio of equity to total liabilities (X_4), the higher the Z_{auto} score for Toyota car dealers in Romania, indicating a more balanced financial structure and lower dependence on external financing;
H5: Asset utilisation efficiency (X_5) positively influences the Z_{auto} score of Toyota car dealers in Romania, reflecting a successful commercial activity;
H6: There is a positive relationship between the share of inventories in total assets (X_6) and the Z_{auto} score for Toyota car dealers in Romania, with an adequate or high level of inventories contributing to an increased ability to meet customer demand and, implicitly, to maintaining financial stability.

To test these hypotheses, we will use a multiple linear regression analysis, in which the Z_{auto} score represents the dependent variable, and $X_1 - X_6$ are the explanatory variables. This step will allow us to assess the significance and the impact of each indicator on the estimated bankruptcy risk.

III. BANKRUPTCY RISK ANALYSIS AND MODELLING

Car dealers are a central element of the automotive industry, providing a direct link between manufacturers and consumers. They play an important role in the distribution, promotion and servicing of vehicles. In this context, the applied analysis was carried out on a sample of 27 car dealers in Romania authorised to sell Toyota cars, selected to reflect the geographical and structural diversity of the national network (see Figure 1). Therefore, based on the assumptions made above and the theoretical model built around the composite score Z_{auto}, we aim to test the statistical links between the estimated level of bankruptcy risk and Altman's financial indicators $\boldsymbol{X_1}$ is "Working capital / Total assets" - considered relevant in managing short-term financial difficulties, $\boldsymbol{X_2}$ is "Retained profits/ Total assets" - reflects the financial position, $\boldsymbol{X_3}$ is "Earnings before interest and taxes (EBIT) / Total assets" - considered a superior measure of profitability relative to cash flow, $\boldsymbol{X_4}$ is "Market value of equity / Carrying amount of total liabilities" - long-term financial sustainability, $\boldsymbol{X_5}$ is "Sales / Total assets" - reflects how

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efficiently the company uses its assets to generate revenue (Altman, 2000) and the new indicator proposed by the authors X_6 is Inventories / Total assets.

Based on the above, we have constructed four multiple linear regression models, all based on the classic Altman model indicators, supplemented with the new indicator specific to dealers of automotive products, X_6 is Inventories / Total assets. The proposed models are:

1. The estimated level Z_{auto} is determined by the financial indicators X_1, X_2, X_3, X_4 and X_5 .
2. The estimated level Z_{auto} is determined by the financial indicators X_1, X_2, X_3, X_4, X_5 and X_6 .
3. The estimated level Z_{auto} is determined by the financial indicators X_1, X_3, X_4 and X_5 .
4. The estimated level Z_{auto} is determined by the financial indicators X_1, X_3, X_4, X_5 and X_6 .

The purpose of these models was to assess the influence of each financial indicator on the Z_{auto} score and to identify the optimal combination of variables for estimating the risk of bankruptcy among Toyota car dealers in Romania. To assess the significance of the linear regression model, an ANOVA table was determined, the results of which are presented below:

Table 2. Anova

Model		Sum of Squares	df	Mean Square	F	Sig
1	Regression	350.913	5	70,183	83,558	.000[b]
	Residual	317,493	378	.840		
	Total	668,406	383			
2	Regression	357,367	6	59,561	72,192	.000[b]
	Residual	311,040	377	.825		
	Total	668,406	383			
3	Regression	350,619	4	87,655	104,539	.000[b]
	Residual	317,787	379	.838		
	Total	668,406	383			
4	Regression	356,958	5	71,392	86,647	.000[b]
	Residual	311,448	378	.824		
	Total	668,406	383			

a. Dependent Variable: Z_{auto}
b. Predictors: (Constant), 1) X_5, X_4, X_3, X_1, X_2; 2) X_6, X_4, X_3, X_1, X_5, X_2; 3) X_5, X_4, X_3, X_1; 4) X_6, X_4, X_3, X_1, X_5

Source: Authors Computation with the aid of IBM SPSS Statistics, version 26

The results of the statistical significance tests presented in Table 2 (ANOVA) confirm validation for all four models, indicating that the included variables explain the variation in the Z_{auto} score to a significant extent. These results support the relevance of adapting the Altman model to the specific characteristics of the automotive industry and the usefulness of including the additional indicator X_6 in the financial risk analysis of Toyota car dealers in Romania. Analysing the results presented in the ANOVA table, it can be observed that, according to the least squares method, the best performing regression model is the one that includes all six financial indicators: X_1, X_2 , X_3, X_4, X_5 and X_6. This model has the best ability to explain the variation in the Z_{auto} score and a high statistical significance. The second best performing model is the one that includes the indicators X_1, X_3, X_4, X_5 and X_6 , in which the absence of the variable X_2 slightly reduces the explanatory power, but maintains the economic and statistical relevance for assessing the bankruptcy risk of Toyota car dealers in Romania. The two models show that car dealers' inventory holdings are a significant factor in explaining the variation in bankruptcy scores. The financial indicators X_1, X_3, X_4, X_5 were used in all four models tested, and the results show that they consistently influence the Z_{auto} score.

Following the application of multiple linear regression, the *Model Summary* table was generated, which summarises the explanatory power of each model obtained.

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate	Durbin-Watson
1	.725[a]	.525	.519	.916	1,323
2	.731[a]	.535	.527	.908	1,324
3	.724[a]	.525	.520	.916	1,328
4	.731[a]	.534	.528	.908	1,331

a. Predictors: (Constant), 1) X_5, X_4, X_3, X_1, X_2; 2) X_6, X_4, X_3, X_1, X_5, X_2; 3) X_5, X_4, X_3, X_1; 4) X_6, X_4, X_3, X_1, X_5
b. Dependent Variable: Z_{auto}

Source: Authors Computation with the aid of IBM SPSS Statistics, version 26

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Analysing Table 3, we can see that the highest correlation is for model 2, followed by model 4, which confirms that the presence of the financial indicator X_6 is important for assessing the risk of bankruptcy among Toyota car dealers in Romania.

To assess the individual influence of each financial indicator on the risk of bankruptcy among Toyota car dealers in Romania, the table below will be analysed:

Table 4. Coefficients

Model		Unstandardised Coefficients B	Unstandardised Coefficients Std. Error	Standardised Coefficients B	t	Sig
1	(Constant)	3.169	.		51,319	.
	X_1	1,065	.084	.520	12,616	.000
	X_2	.178	.	.038	.592	.554
	X_3	.869	.293	.174	2,960	.003
	X_4	.033	.009	.129	3,601	.000
	X_5	.143	.012	.549	11,961	.
2	(Constant)	3,131	.063		49,918	.000
	X_1	1.158	.090	.566	12,860	.000
	X_2	.209	.298	.045	.703	.482
	X_3	.759	.293	.152	2,586	.010
	X_4	.033	.009	.130	3,654	.000
	X_5	.128	.013	.491	9,805	.000
	X_6	.512	.183	.133	2,797	.005
3	(Constant)	3,161	.060		52,791	.
	X_1	1,055	.083	.516	12,767	.00
	X_3	.998	.195	.200	5,120	.000
	X_4	.033	.009	.130	3,645	.000
	X_5	.146	.011	.560	13,297	.
4	(Constant)	3,121	.061		51,136	.00
	X_1	1,146	.088	.56	12,991	.
	X_3	.913	.196	.183	4,662	.000
	X_4	.034	.009	.131	3,703	.000
	X_5	.131	.012	.504	10,876	.000
	X_6	.507	.183	.131	2,774	.006

a. Dependent Variable: Z_{auto}

Source: Authors Computation with the aid of IBM SPSS Statistics, version 26

Based on the estimated coefficients of the independent variables presented in the table above, we write the multiple linear regression equations corresponding to the four models analyzed. These equations express the relationship between the Z_{auto} score and the financial indicators included, allowing the quantification of the impact of each variable on the estimated bankruptcy risk for Toyota car dealers in Romania. Therefore, the form of the equations, with both unstandardised and standardised coefficients, is presented in the table below.

Table 5. Regression equations of the Z_{auto} score

Model	Coefficients	Equation
1	Unstandardised	$Z_{auto} = 3.169 + 1.065 * X_1 + 0.178 * X_2 + 0.869 * X_3 + 0.033 * X_4 + 0.143 * X_5$
	Standardised	$Z_{auto} = 0.520 * X_1 + 0.038 * X_2 + 0.174 * X_3 + 0.129 * X_4 + 0.549 * X_5$
2	Unstandardised	$Z_{auto} = 3.131 + 1.158 * X_1 + 0.209 * X_2 + 0.759 * X_3 + 0.033 * X_4 + 0.128 * X_5 + 0.512 * X_6$
	Standardise	$Z_{auto} = 0.566 * X_1 + 0.045 * X_2 + 0.152 * X_3 + 0.130 * X_4 + 0.491 * X_5 + 0.133 * X_6$
3	Unstandardised	$Z_{auto} = 3.161 + 1.055 * X_1 + 0.998 * X_3 + 0.033 * X_4 + 0.146 * X_5$
	Standardise	$Z_{auto} = 0.516 * X_1 + 0.200 * X_3 + 0.130 * X_4 + 0.560 * X_5$
4	Unstandardised	$Z_{auto} = 3.121 + 1.146 * X_1 + 0.913 * X_3 + 0.034 * X_4 + 0.131 * X_5 + 0.507 * X_6$
	Standardised	$Z_{auto} = 0.560 * X_1 + 0.183 * X_3 + 0.131 * X_4 + 0.504 * X_5 + 0.131 * X_6$

Source: Prepared by authors

According to the regression equations obtained in Table 5, for all four models, it can be observed that, in all tested models, an increase in the value of the financial indicator X_1 determines an increase in the Z_{auto} score. This positive relationship suggests that a solid working capital position, relative to asset size, directly contributes

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to improving the short-term financial stability of car dealers. Toyota car dealers in Romania must maintain a high level of this indicator to ensure the continuity of their commercial activity. A high value of financial indicator X_1 contributes to placing the company in a safe zone in terms of bankruptcy risk.

Models 1 and 2 show that an increase in the value of the financial indicator X_2 leads to an increase in the Z_{auto} score. This indicator reflects the company's financial stability accumulated over time and its ability to sustain itself from its own resources. In the context of car dealers in Romania, a high level of reported results reflects positive financial performance and a sustained ability to generate profits. Many car dealers offer their customers the opportunity to purchase cars through leasing, which requires solid partnerships with financial institutions and a high degree of credibility in the market. However, we note that for this indicator, the Sig. value is greater than 0.05, which means that the relationship between X_2 and the Z_{auto} score is not statistically significant, which is why we did not take this indicator into account in models 3 and 4. This situation can be explained by the fact that not all Toyota dealers analyzed have a long financial history reflecting consistent accumulated profits. Six of the 27 dealers have been operating for a relatively short time, which limits the relevance of this indicator in the models determined. Therefore, the data does not provide sufficient statistical evidence to confirm that the influence of X_2 on the Z_{auto} score is significant in the sample analysed. In a competitive sector such as the automotive industry, where customers have high expectations regarding model availability and after-sales service quality, a positive and sustainable EBIT helps Toyota dealers remain competitive and position themselves in the safe zone in terms of bankruptcy risk.

Another indicator used in the analysis is X_3, which represents a company's operating profitability and shows how efficiently assets are used to generate revenue. In all four models determined, a steady increase in this financial indicator leads to an increase in the Z_{auto} score, confirming that X_3 is an indicator of financial sustainability, a conclusion supported by the study conducted by Rashid et al. (2023). Indicator analysed in all models is the X_4, and the results show that its increase consistently leads to an increase in the Z_{auto} score. This indicator is a key indicator of long-term financial sustainability and reflects the extent to which the company can withstand a decline in asset value before liabilities exceed assets, which would lead to insolvency (Rashid et al., 2023). In this case, there is a positive relationship, confirming that the balanced financial structure of Toyota car dealers in Romania, with a higher ratio of equity to debt, directly contributes to reducing the risk of bankruptcy, with 25 dealers in the safe zone.

The financial indicator X_5 is another indicator used in all specified models, shows us that its increase leads to an increase in the Z_{auto} score. According to Chuvakhin & Gertmenian (2003), this indicator reflects the company's ability to efficiently convert available resources into revenue. A high level of the X_5 highlights that the car dealer is able to convert its resources into actual sales, which allows it to maintain liquidity and finance its current operations without major pressure on cash flow. For a Toyota dealer in Romania, this may mean rapid turnover of car stocks and good utilisation of related services (authorised servicing, sales of original parts and accessories). This explanation was an important argument for us to introduce a new financial indicator into the model X_6, through which we aimed to analyse the impact that inventory levels have on financial performance and, implicitly, on the risk of bankruptcy of car dealers in Romania. We considered that in the automotive industry, and especially in the case of Toyota dealers, inventories are not just an accounting item, but a strategic factor that can directly influence the ability to respond to customer demand and maintain business sustenability. Therefore, the analysis of the results obtained for models 2 and 4, considered statistically the best performers, shows that the X_6 indicator has a positive impact on the Z_{auto} score. The positive coefficient associated with this indicator suggests that, in the case of Toyota car dealers in Romania, an adequate or even high level of inventory contributes to increased financial stability and reduced risk of bankruptcy. This finding confirms our initial assumption: in the automotive industry, inventory is not just a capital constraint, but also a strategic asset. For Toyota dealers, the immediate availability of a diverse model portfolio is essential to respond promptly to market demands and maintain a steady flow of sales. In addition, having substantial inventories allows for more effective use of promotional campaigns and seasonal offers, ensuring an important competitive advantage. From a financial perspective, the share of inventories in total assets reflects not only the dealer's supply policy, but also its ability to manage the operating cycle in order to balance liquidity with product availability. Our results show that dealers who manage to maintain this balance achieve higher Z_{auto} scores, positioning themselves in a safe zone in terms of bankruptcy risk.

The results obtained confirm all six hypotheses, H1 – H6, and demonstrate the relevance of each indicator in explaining the financial sustainability of Toyota car dealers in Romania. In particular, we believe that the inclusion of the financial indicator X_6 adds value to Altman's model, highlighting the specific nature of the Toyota car dealership sector and the positive influence that optimal inventory levels have on financial stability.

Table 6. Histogram and Chart P-P Plot for each model

Model	Histogram	P-P Plot Chart

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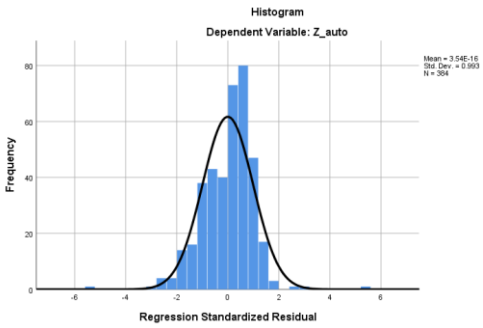
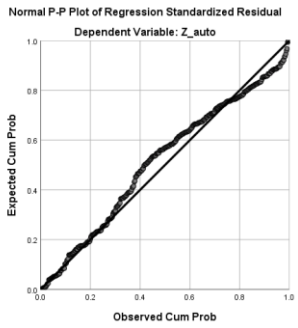
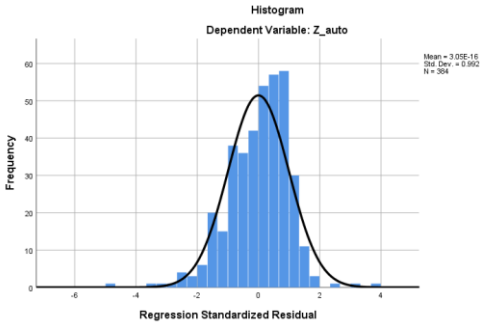
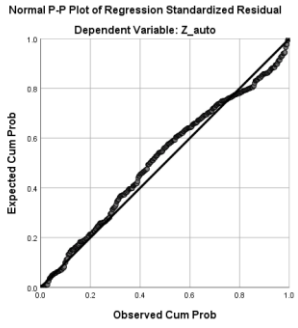
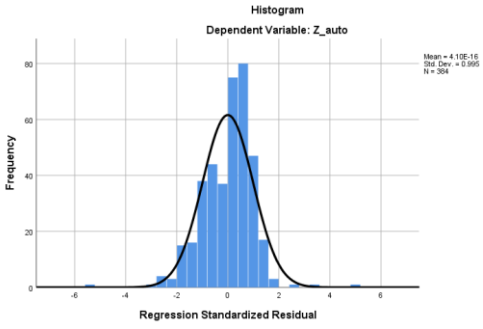
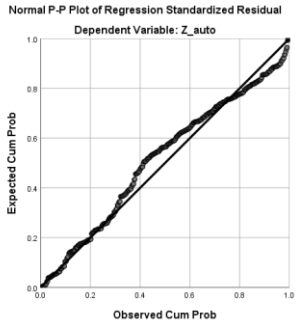
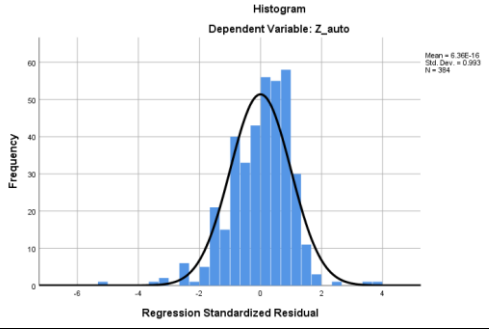
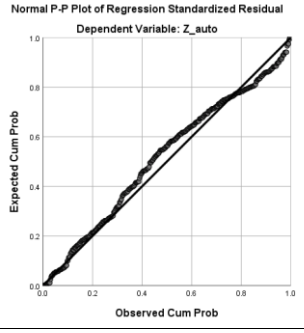
1		
2		
3		
4		

Source: Authors Computation with the aid of IBM SPSS Statistics, version 26

Analysing the Z_{auto} score for the 27 car dealers in Romania authorised to sell Toyota cars, we find that 25 dealers are in the safe zone and 2 dealers are in the grey zone. This distribution shows that the Toyota dealer network in Romania is mostly financially sustainable, but there are isolated cases that require consolidation measures.

To ensure financial sustainability and avoid the risk of bankruptcy, Toyota car dealers in Romania must focus their efforts on those financial factors that, according to the analysis, have the greatest influence on the Z_{auto} score. First, working capital management plays a key role. A high ratio of current assets to current liabilities ensures the liquidity necessary to operate under optimal conditions. This requires strict control over receivables and payment terms to suppliers, as well as the creation of a financial reserve to cover weaker sales periods, such as seasonal ones. Equally important is the efficiency with which assets are converted into sales. Dealers who manage to maximise the value of their showroom and service space, diversify their offering by including new cars, especially hybrid and electric vehicles, original parts and accessories, and combine traditional sales with online channels are more likely to increase their turnover and stabilise their cash flow. Operating profitability remains a key indicator of financial sustainability. It can be improved through careful cost management without compromising the quality of customer service. Integrated after-sales service packages, such as extended warranties

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and regular mai ntenance, not only build customer loyalty but also generate recurring revenue. Negotiating better commercial terms with the Toyota importer can also help increase profit margins. The capital structure needs to be strengthened to reduce dependence on external financing. A higher share of equity, achieved by reinvesting a significant portion of profits, provides stability and the ability to invest in development. At the same time, regular analysis of the cost of financing can prevent the accumulation of burdensome debt. Another key aspect identified in the research is the level of inventories. For Toyota dealers, inventories are not just an accounting resource, but a strategic tool that can ensure market competitiveness. Maintaining an optimal level, adapted to demand and seasonality, as well as avoiding tying up capital in hard-to-sell models, are key elements of effective management. Last but not least, a positive financial history contributes to the dealer's image and credibility with banks and business partners. Even if the direct influence of this indicator in the model is lower, long-term stability is supported by the transparency and consistency of the reported financial results. Therefore, we believe that this strategy combines measures to increase liquidity, maximise sales, optimise costs and strengthen capital, with a special focus on inventory management, adapting to the specific realities of the Romanian automotive market and the Toyota dealer network.

IV. CONCLUSION

The Altman model is a well-established tool in financial decision-making theory, providing a solid basis for assessing bankruptcy risk and for developing optimal strategies to ensure the sustainability of companies. This study analysed the application of the Altman model in assessing bankruptcy risk for car dealers in Romania authorised to sell Toyota cars, demonstrating the usefulness of this tool in identifying critical financial factors and anticipating potential vulnerabilities. The model was built based on the classic indicators of the Altman formula: the X_1 is "Working capital / Total assets", X_2 is "Retained profits/ Total assets", X_3 is "Earnings before interest and taxes (EBIT) / Total assets", X_4 is "Market value of equity / Carrying amount of total liabilities", X_5 is "Sales / Total assets". In order to more accurately reflect the economic realities specific to the automotive industry in Romania and, in particular, to Toyota dealers, we have improved the model by introducing a new financial indicator X_6 , which is Inventories / Total assets. We believe that this indicator captures the strategic importance of inventories in the business of car dealers, where the immediate availability of vehicles is essential to meet customer demand and maintain market competitiveness. The integration ofX_6 into Altman's model has allowed us to more accurately assess financial risk, the Z_{auto} score, highlighting that, unlike other sectors, in the automotive industry, an adequate level of inventory can contribute positively to a company's financial stability.

The comparative analysis of the regression models obtained shows that, of the four variants tested, Model 2, which has as independent variables the Altman indicators and the financial indicator X_6, is the most statistically significant and the most appropriate for future forecasts. The results obtained based on the analysis of the financial reports of the 27 Toyota car dealers in Romania show that the adaptation made to the model is correct and useful. We consider that Model 2 obtained in this study is a decision-making analysis tool for developing optimal strategies to help car dealers avoid the risk of bankruptcy and maintain their financial sustainability. Therefore, based on this improved model, the optimal strategy for maintaining the financial sustainability of Toyota dealers in Romania involves: optimising working capital, increasing asset efficiency to generate sales, improving operational profitability, strengthening the capital structure, strategically managing inventories and maintaining a positive financial history. Thus, the use of the Altman model, adapted to the realities of the Romanian automotive market, not only supports the decision-making process but also provides a practical framework for developing proactive financial policies capable of ensuring the long-term stability and competitiveness of the Toyota car dealer network.

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