

Financial Risk Analysis of Automotive Industry Based on the Z-Score Model--Taking Yaxing Bus as An Example

Jingwei Zheng^{1, #}, Haoyu Tong^{2, #}, Wenbo Duanmu^{3, #, *}

¹ School of Management, China University of Mining & Technology (Beijing), Beijing, China, 100083

² College of Finance and Economics, Tibet University, Lasa, China, 850000

³ School of International studies, University of International Business and Economics, Beijing, China, 100029

* Corresponding Author Email: duanmuwenbo@163.com

#These authors contributed equally.

Abstract. In order to achieve long-term development, enterprises need to strengthen the monitoring of financial risk and timely adjustment of business strategy. This paper takes Yangzhou Yaxing Bus Co., Ltd. (referred to as "Yaxing Bus") as the research object, calculates its solvency, operating ability, and profitability, and analyzes the current situation and causes of financial risk of Yaxing Bus based on Z-score Model, summarizes and proposes relevant measures. The results show that the solvency, operating ability, and profitability of Yaxing Bus are weak, and the financial risk is high and the enterprise should take measures as soon as possible to mitigate the financial risk. This paper verifies the feasibility of the application of the Z-score model in the automotive vehicle industry by analyzing the financial data of Yaxing Bus, which provides an effective financial risk early warning tool for the management of the enterprise and helps to improve the financial management level and risk prevention and control ability of the enterprises in the industry.

Keywords: Yaxing Bus, Financial Risk, Z-score Model, Automotive Industry.

1. Introduction

The automotive manufacturing industry holds a significant position in China's national economy. With the rising concern over climate change and the implementation of the "carbon neutrality" goal, the government has introduced policies to support the rapid development of the new energy vehicle (NEV) sector. As a result, the market has expanded, and various emerging "new forces" in car manufacturing have appeared. However, NEV companies face intense competition, overcapacity, and low consumer acceptance, leading to sales falling short of expectations, high financial demands, slow returns, and financial risk management becoming critical to the healthy development of these companies [1].

Yaxing Bus Co., Ltd. (referred to as "Yaxing Bus"), a veteran Chinese bus manufacturing company, traces its history back to the 1950s and was once a leader in China's bus industry. In 1999, Yaxing Bus went public on the Shanghai Stock Exchange, becoming one of the few listed bus companies. However, the company has experienced multiple setbacks, including the arrest of former chairman Gu Chujun for economic crimes and a suspension from the stock market after three consecutive years of losses. Although Yaxing Bus made some progress in transitioning to new energy vehicles after 2011, its sales significantly declined due to the reduction in national NEV subsidies, changes in the market environment, and internal business issues. By 2020, the COVID-19 pandemic further impacted its performance, with annual sales plummeting from 2,000 units in 2019 to less than 500, leaving the company in severe operational difficulties.

On August 3, 2024, Yaxing Bus, once known as the "No. 1 Stock in Yangzhou," announced its voluntary delisting, drawing widespread attention. Therefore, this paper takes Yaxing Bus as the research subject and conducts an in-depth analysis of the financial status of NEV companies using

the Z-score model. This analysis aims to help companies in the NEV industry identify and manage potential financial risks to ensure sustainable and stable development.

2. Related concepts and theoretical foundation

2.1. Overview of financial risk

Financial risk refers to the uncertainty and potential negative effects on a company's financial performance and stability due to internal and external factors during its operations. This risk can affect profitability, cash flow, debt servicing, and overall financial health, potentially leading to distorted financial reporting and economic losses or bankruptcy[2].

To identify financial risk, scholars scrutinize a company's financial status and indicators, including the analysis of financial statements (balance sheet, income statement, and cash flow statement) and the computation of financial ratios such as the current ratio, quick ratio, debt-to-equity ratio, and interest coverage ratio. These metrics help assess financial health and uncover potential risks. Additionally, external factors like macroeconomic changes, industry trends, and regulatory alterations are evaluated for their impact on financial risk, with interest rate fluctuations being a significant example.

After identifying financial risks, companies must establish robust monitoring and assessment mechanisms to track risk dynamics and report to management. This includes regular risk assessment updates to align risk management strategies with current conditions. Establishing key risk indicators for vigilant monitoring is essential for preempting potential financial threats[2]. The systematic identification, analysis, and evaluation of financial risks are crucial for financial management, enabling the development of effective risk mitigation strategies, enhancing financial stability, and ensuring sustainable business growth.

2.2. Theoretical foundation

2.2.1 Overview of the Z-Score model

The Z-Score model, developed by American financial economist Edward I. Altman in 1968, is a financial model used to predict corporate bankruptcy risk [3]. The model generates a Z-score by combining a series of weighted financial ratios, and based on the score, the company's financial health and bankruptcy risk can be evaluated. The Z-Score model is widely used in assessing financial risk, particularly in manufacturing and capital-intensive industries.

2.2.2 Calculation formula of the Z-Score model

The classic Z-Score model primarily targets manufacturing companies, and its calculation formula is as follows:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5 \quad (1)$$

Table 1 shows the meaning and calculation methods of the variables X1 to X5.

Table.1. Calculation methods and definitions of variables in the Z-Score model

Calculation Methods	Definitions
$X_1 = \frac{\text{Working Capital}}{\text{Total Assets}}$	Reflects the company's short-term debt Repayment ability
$X_2 = \frac{\text{Retained Earnings}}{\text{Total Assets}}$	Measures the company's cumulative profitability
$X_3 = \frac{\text{EBIT}}{\text{Total Assets}}$	Evaluates the efficiency of asset utilization
$X_4 = \frac{\text{Market Value of Equity}}{\text{Total Liabilities}}$	Reflects the company's capital structure
$X_5 = \frac{\text{Revenue}}{\text{Total Assets}}$	Measures the effectiveness of the company's operational activities

The Z-score inversely correlates with a company's financial risk, as detailed in Table 2's criteria. Companies with Z-scores below 1.81 are at high risk of bankruptcy due to significant financial stress. Those with scores between 1.81 and 2.675 face moderate risk and a substantial two-year bankruptcy probability if financial and operational performance does not improve. Scores above 2.675 suggest robust financial health and a low likelihood of bankruptcy.

Table.2. Z-Score model interpretation criteria

Z-Score	Financial Risk and Probability of Bankruptcy
$Z < 1.81$	The company faces severe financial risk, and the probability of bankruptcy is very high
$1.81 \leq Z < 2.675$	The company is in a grey zone; if financial and operational conditions are not improved, there is a considerable probability of bankruptcy within two years
$Z \geq 2.675$	The company's financial situation is sound, and the probability of bankruptcy is low

3. Literature review

3.1. Domestic and international literature review

The original approach to warning of corporate insolvency was a statistical classification technique applied to a set of samples containing insolvent and non-insolvent firms. Among them, financial economist Edward Altman in 1968 had observed and analyzed the U.S. production enterprises, using 22 financial ratios, the famous 5-variable Z-score model established by screening based on multivariate statistical methods, which has been used to this day with its high accuracy[4]. The model is used to measure the financial health of a company and to diagnose and predict the likelihood of the company's bankruptcy in the coming period. In addition to these, foreign research results include small business research models[5], general algebraic models, mathematical analysis models, mathematical planning models[6], etc.

The research method of domestic enterprise bankruptcy early warning mainly started in the 1980s, while the relevant financial crisis early warning models were put forward one after another only at the end of the 1990s. Zhou Shouhua et al. (1996) were the first to draw on the Z-score model and added cash flow ratios to propose “a new forecasting model for management use but different from the traditional analysis of corporate solvency - the F-score model,” which has been forecasted. The accuracy of its predictions is as high as 70%[7]. Bai Haobai (2024) analyzed the financial data of Luckin Coffee Company for the years 2017-2022 based on the Z-score model, and the results showed that the company has a high level of financial risk, but it is predictable that it is moving towards a turnaround[8].

3.2. Review of literature

Based on the reading and combing of the relevant literature on the theoretical research of financial risk evaluation and the application of the financial risk evaluation model at home and abroad, it can be understood that the initial establishment and research of the Z-score model originated from abroad, and the international understanding of financial risk has gradually developed into a unified and systematic identity. Domestic scholars, on the other hand, have continuously improved it to make its adaptability stronger and applied it in various fields and industries, and also derived numerous new-style models, such as the financial early warning model of listed companies with improved FOA algorithm[9], entropy weight TOPSIS method[10], and random forest algorithm financial risk early warning model[11] and other theories. The Z-score model is more mature, accurate, and applicable, but previous research for the automobile industry model application is less, so this paper mainly adopts the Z-score model to analyze the financial risk of the typical enterprises in the automotive industry - Yaxing Bus, to make up for the research gap in this field.

4. Case selection and explanation

4.1. Overview of Yaxing Bus

Yangzhou Yaxing Bus Co., Ltd. (referred to as "Yaxing Bus") was once among the first 300 key enterprises in China and was listed on the Shanghai Stock Exchange in 1999, becoming one of the few publicly listed bus companies. Yangzhou Yaxing Bus Co., Ltd. (referred to as "Yaxing Bus") was once among the first 300 key enterprises in China and was listed on the Shanghai Stock Exchange in 1999, becoming one of the few publicly listed bus companies. In 1997, Yaxing formed a joint venture with Germany's Daimler-Chrysler to establish Yaxing Mercedes-Benz Bus Company, which briefly led the Chinese bus industry. However, internal competition due to overlapping products weakened Yaxing Mercedes-Benz's market performance, and the partnership ended in 2007. Yaxing Bus itself also encountered difficulties, incurring losses in 2003 and was subsequently acquired by Yangzhou Greco. In 2005, due to the arrest of Gu Chujun and consecutive losses, *ST Yaxing was delisted, later resuming trading in 2007. In 2011, Yaxing's controlling interest was transferred to Weichai Yangzhou, facilitating its transition to new energy. Although it reached a record high net profit in 2016, subsidy reductions and other factors led to cumulative losses of 689 million RMB from 2020 to 2023. In August 2024, the controlling shareholder proposed the company's delisting.

Table.3. Development history of Yaxing Bus from 1997 to 2024

Year	Development History
1997	Jointly established Yaxing Mercedes-Benz Bus Co., Ltd. with Daimler-Chrysler (Mercedes-Benz)
1998	Initiated the establishment of Yangzhou Yaxing Bus Co., Ltd., with Yaxing Group as the principal initiator
1999	Yaxing Bus was listed on the Shanghai Stock Exchange
2003	Reported its first loss; Yaxing Bus was acquired by Yangzhou Gree
2005	Yaxing Bus Chairman Gu Chujun was arrested
2006	*ST Yaxing was suspended from listing due to three consecutive years of losses, and Yangzhou Gree signed a share transfer agreement with Yaxing Group
2007	Yaxing Bus resumed its stock market listing
2011	The controlling stake of Yaxing Bus was transferred to Weichai Yangzhou, a subsidiary of Shandong Heavy Industry
2024	The controlling shareholder proposed voluntary delisting through a shareholder resolution

Yaxing Bus is one of the oldest bus-manufacturing companies in China. It pioneered the industry with achievements such as developing the first domestic bus chassis, ranking first in sales for seven consecutive years, and establishing a joint venture with Mercedes-Benz. Its development reflects the changes and challenges in China's bus industry.

In recent years, Yaxing Bus's financial situation has deteriorated, with continuous net losses, a high asset-liability ratio, and multiple bank account freezes. This reveals widespread financial management issues in the automobile manufacturing industry, such as poor cost control, intensified market competition, and increased difficulty in financing.

Yaxing Bus recently announced its voluntary delisting, mainly due to sustained negative net assets, delisting risk warnings, industry competition, and external pressures for higher-quality capital market development. This move has sparked widespread market discussion, with some investors expressing concern about the company's future, while others believe delisting may help the company overcome its difficulties and achieve transformation. Analyzing this case provides an opportunity to explore the financial risks and response strategies faced by the automobile industry.

In conclusion, Yaxing Bus serves as a representative case in the industry. Its history, financial challenges, and delisting decisions provide valuable insights for studying financial risks in the automobile manufacturing sector.

5. Analysis of debt repayment ability

Analyzing debt repayment ability helps in understanding the debt structure and financial resource allocation, which can reveal the complexity of a company's financial structure and its impact on economic activities. Based on previous scholarly research, this paper selects financial indicators such as the current ratio, quick ratio, and cash flow ratio to analyze Yaxing Bus's short-term debt repayment ability, and uses indicators such as the asset-liability ratio, interest coverage ratio, and equity multiplier to assess its long-term debt repayment ability [12].

5.1. Short-term debt repayment ability analysis

As a company engaged in bus R&D, production, and sales, Yaxing Bus needs to focus on current assets to ensure short-term solvency. The years 2014-2023 marked a critical phase of new energy transformation, policy changes, and potential delisting. Table 4 shows key short-term solvency indicators, including current ratio, quick ratio, and cash flow ratio.

Generally, a higher current ratio indicates stronger debt repayment capability, with a typical level around 2. Yaxing Bus's current ratio remained stable at approximately 1.1, below the industry average; it rose during 2017-2018 but fell sharply in 2019, primarily due to increase after-sales costs in the new energy business, which led to a 36.09% rise in liabilities.

The quick ratio reflects Yaxing Bus's ability to convert assets into cash quickly, generally staying around 1, sufficient to cover short-term liabilities. The trend of the quick ratio mirrors that of the current ratio, with accounts receivable rising significantly from 2016 to 2018 and gradually declining after 2019. From 2014 to 2020, accounts receivable accounted for over 80% of quick assets, dropping to above 50% after 2020. The long collection period for accounts receivable weakens short-term debt repayment capacity.

As a complete vehicle sales company with high individual product value, a cash flow ratio above 0.5 generally indicates strong debt repayment capacity. However, from 2014 to 2018, Yaxing Bus's cash flow ratio was negative, gradually rising after 2019 to a peak of 0.26 in 2021, with a slight rebound in 2023, yet still below 0.5. Since 2016, the company benefited from new energy policies, boosting core revenue and enhancing short-term solvency. Despite revenue declines from 2020 to 2023, accumulated accounts receivable from previous years kept its short-term debt repayment capacity weak.

Table.4. Overview of Yaxing Bus's short-term debt repayment indicators (2014-2023)

Indicator/Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Current Ratio	1.09	1.12	1.03	1.51	1.62	0.94	1.21	1.22	1.31	1.08
Quick Ratio	0.98	1.04	0.98	1.44	1.56	0.91	1.15	1.11	1.21	0.93
Cash Flow Ratio	-0.18	-0.09	-0.16	-0.08	-0.12	0.02	0.13	0.26	0.15	0.24

5.2. Long-term debt repayment ability analysis

Yaxing Bus requires long-term debt to finance its vehicle research and development, market entry, and project construction as a bus manufacturing company. Therefore, its long-term debt repayment ability is especially crucial. Commonly used indicators to measure this ability include the asset-liability ratio, interest coverage ratio, and equity multiplier. Table 5 presents the major long-term debt repayment indicators for Yaxing Bus from 2014 to 2023.

The debt-to-asset ratio is an important measure of long-term solvency, with a healthy range typically between 60%-70%. As shown in Table 5, Yaxing Bus's debt-to-asset ratio was approximately 95% from 2014 to 2019, rising to 97% in 2020-2021, and reaching 104.3% in 2023, indicating insolvency. The high debt ratio increases financial costs and presents a significant bankruptcy risk. Although new energy policies provided opportunities, the company's unsound capital structure, particularly after the 2020 subsidy adjustments, revealed vulnerabilities in financial management and weakened long-term solvency.

The interest coverage ratio reflects a company's ability to meet interest payments. Generally, an interest coverage ratio greater than 1 indicates sufficient interest payment capacity. Yaxing Bus's interest coverage ratio was negative in 2014, increased in 2015-2016, reaching 3.345 in 2016, and slightly declined during 2017-2019 but remained above 1, indicating strong interest payment capacity. However, since 2020, its interest coverage ratio dropped to negative, reaching -6.773 in 2023, indicating that operating profits could no longer cover interest expenses and showing a gradual weakening of long-term solvency.

The equity multiplier reflects the level of leverage, with a normal value ranging between 2 and 3. Yaxing Bus's equity multiplier remained high for an extended period, although it slightly decreased during 2017-2019, it still approached 19, surged to 39.44 in 2020, dropped to 12.309 in 2022, and even turned negative in 2023. While high leverage provided short-term gains, it exacerbated financial risks. The negative equity multiplier in 2023 indicates a severely imbalanced capital structure, with erosion of shareholder equity and extremely weak long-term solvency.

Table.5. Overview of Yaxing Bus's long-term debt repayment indicators (2014- 2023)

Indicator/Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
debt-to-asset ratio (%)	94.40	95.60	95.60	94.50	94.70	94.70	97.40	97.20	91.90	104.30
Interest Coverage Ratio	-4.5	1.46	3.35	1.56	1.14	1.22	-0.33	0.83	-1.65	-6.77
Equity Multiplier	16.90	18.52	21.75	17.20	17.99	17.91	38.44	34.62	11.31	-24.09

5.3. Comparison of debt repayment ability in the same industry

BYD is a leading company in the new energy vehicle sector both in China and globally. Its market share, technological strength, and brand influence are all at the forefront of the industry. Therefore, using BYD as a comparison can provide a clear reflection of Yaxing Bus's relative position in the new energy vehicle and overall automobile market.

This paper compares three key debt repayment ability indicators: asset-liability ratio, equity multiplier, and cash flow coverage ratio, as shown in Figures 1, 2, and 3.

As shown in Figure 1, BYD's debt-to-asset ratio fluctuated but overall remained at a healthy level, even with an increase in 2022-2023, of which 36.7% was accounts payable. BYD's debt growth was primarily due to capacity expansion to meet rapidly increasing business demands, with both sales revenue and profits rising sharply, leading to low debt risk and strong repayment capacity. In contrast, Yaxing Bus saw a continuous increase in debt due to capital expenditures in its new energy business. Although its new energy business developed to some extent, profits were insufficient to offset debt growth. The debt-to-asset ratio rose yearly, surpassing 100% in 2023, indicating an unhealthy financial structure and extremely weak debt repayment capacity.

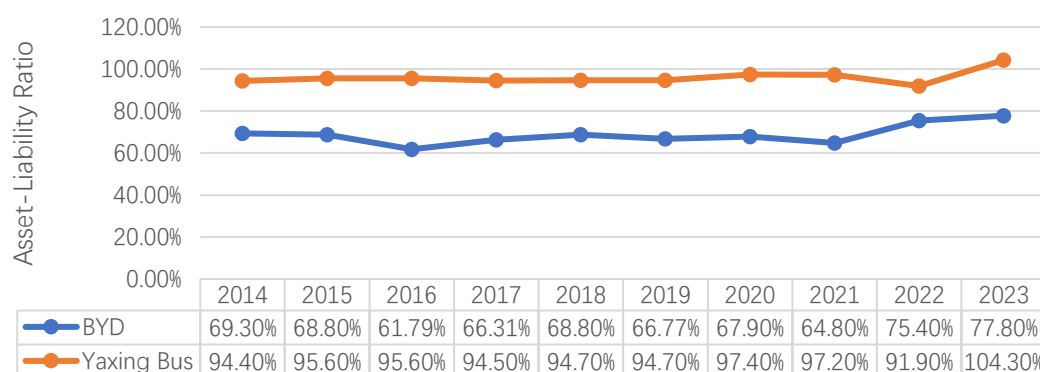


Figure 1. Comparison of asset-liability ratios between BYD and Yaxing Bus

As shown in Figure 2, Yaxing Bus's equity multiplier is much higher than BYD's, indicating that Yaxing Bus is more aggressive in using financial leverage, which also means it faces higher financial risks and has very weak long-term debt repayment ability.

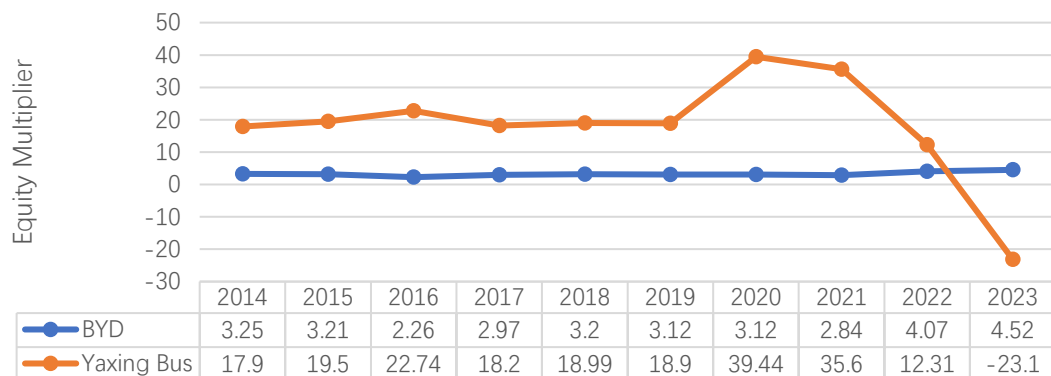


Figure 2. Comparison of equity multipliers between BYD and Yaxing Bus

As shown in Figure 3, BYD and Yaxing Bus made different choices in response to the implementation and adjustments of new energy policies. BYD maintained a lower equity multiplier and significantly increased its cash flow ratio, indicating that BYD was able to quickly and effectively adjust to changes in new energy vehicle policies and market demand while maintaining a stable capital structure and strong debt repayment ability. Yaxing Bus, on the other hand, heavily relied on debt from 2014 to 2019, resulting in an excessively high equity multiplier, which made the company financially vulnerable. Although its cash flow ratio improved after the policy adjustments, the high leverage still made it difficult for the company to overcome its weak long-term debt repayment ability.

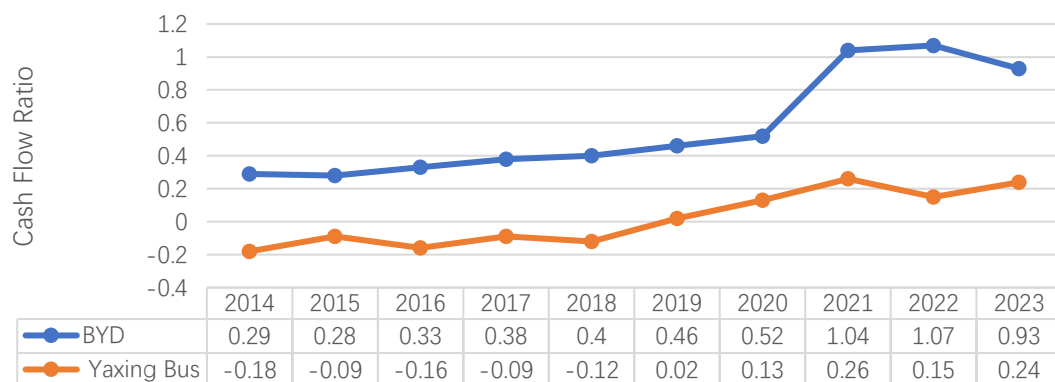


Figure 3. Comparison of Cash Flow Ratios between BYD and Yaxing Bus

In conclusion, Yaxing Bus's debt repayment ability has significantly declined in recent years, showing a high level of financial risk, especially with poor performance in both its asset-liability ratio and equity multiplier. In contrast, BYD's debt repayment ability has remained relatively stable, with its asset-liability ratio and equity multiplier staying at healthier levels, indicating a more stable financial condition and better risk management. Overall, compared to BYD, Yaxing Bus's debt repayment ability is generally weaker.

6. Operational efficiency analysis

The financial indicators of Yaxing Bus reveal significant changes in its operational efficiency over the past decade. By examining three key turnover ratios—accounts receivable turnover, inventory turnover, and total asset turnover—and comparing them with BYD, a benchmark company in the new energy industry, we can gain a clearer understanding of Yaxing Bus's operational efficiency and management performance during this period.

6.1. Analysis of operational efficiency indicators

Table 6 shows the trends in Yaxing Bus's accounts receivable turnover from 2014 to 2023. The company's accounts receivable turnover declined from 1.50 in 2014 to 0.31 in 2020, then slightly recovered to 0.94 by 2023. The low accounts receivable turnover indicates inefficiency in collecting receivables, leading to poor cash flow. Although the turnover improved in 2023, it remained far below its initial levels, reflecting Yaxing Bus's weak operational efficiency. Analysis shows that the company faced severe issues in accounts receivable management and significant declines in revenue during this period, resulting in persistently low turnover rates. Even before its voluntary delisting, Yaxing Bus had not fundamentally improved its accounts receivable management or operational efficiency.

As shown in Table 6, Yaxing Bus's inventory turnover increased annually from 7.95 in 2014 to 19.40 in 2016 but then dropped sharply to 0.40 in 2020. Although it rose again to 6.52 in 2022, it was still far below its previous levels. The company experienced several issues in inventory management, including sales disruptions caused by the downturn in the tourism industry during the pandemic, which led to significant revenue declines and inventory buildup. The drop in inventory turnover negatively affected the company's overall operational efficiency.

Furthermore, Table 6 reveals that Yaxing Bus's total asset turnover decreased from 0.74 in 2014 to 0.46 in 2023, with Table 7 showing a continuous decline below 0.5 after 2017. This persistent decline in total asset turnover reflects decreasing profitability and competitiveness. Analysis indicates that Yaxing Bus struggled with intense external competition, insufficient investment in research and development (R&D), a lack of competitive products, and poor internal management. The company's low asset utilization efficiency made it difficult to generate adequate revenue from its existing assets, contributing to the declining trend in total asset turnover and highlighting its weak operational efficiency.

Table.6. Overview of Yaxing Bus's operational efficiency indicators (2014-2023)

Name/ Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Accounts Receivable Turnover	1.50	1.40	1.38	0.69	0.64	0.67	0.47	0.31	0.98	0.94
Inventory Turnover	7.95	12.18	19.40	12.04	12.07	13.82	0.40	3.17	6.52	4.82
Total Asset Turnover	0.74	0.83	0.93	0.51	0.49	0.52	0.38	0.20	0.50	0.46

6.2. Comparative analysis of operational efficiency in the same industry

Figures 4 and 5 illustrate the trends in accounts receivable turnover, inventory turnover, and total asset turnover for both BYD and Yaxing Bus. As an industry benchmark, BYD's turnover ratios in all three areas showed a steady upward trend. Figure 4 shows that BYD's accounts receivable turnover gradually decreased from 5.43 in 2014 to 2.26 in 2017 but significantly increased to 11.96 by 2023, far exceeding Yaxing Bus during the same period. This indicates that BYD has significantly improved its operational performance and accounts receivable management, outperforming Yaxing Bus by a wide margin.

Figure 4 shows that BYD's inventory turnover remained relatively stable, gradually increasing to 7.22 by 2023. Although it was lower than Yaxing Bus's during the earlier years (2014-2016), BYD demonstrated long-term effectiveness in inventory management and efficient business operations. According to Figure 6, while Yaxing Bus's total asset turnover exhibited a continuous downward trend, BYD's total asset turnover increased steadily from 0.68 in 2014 to 1.07 in 2022, with a slight decline to 1.03 in 2023. This indicates that BYD maintained a high level of asset utilization efficiency over the years.

Through a horizontal comparison with BYD, it becomes evident that Yaxing Bus exhibited poor performance in accounts receivable turnover, current asset turnover, and total asset turnover from 2014 to 2023, indicating significantly weaker operational efficiency and facing severe operational risks. Due to substantial issues in financial management, asset utilization, and operational efficiency,

Yaxing Bus struggled with poor cash flow, low asset utilization, and an inability to maintain normal operations in a highly competitive market. In contrast, BYD demonstrated clear advantages in market competition and management capabilities during the same period. Yaxing Bus's deficiencies in these areas ultimately contributed to its long-term operational difficulties and voluntary delisting.

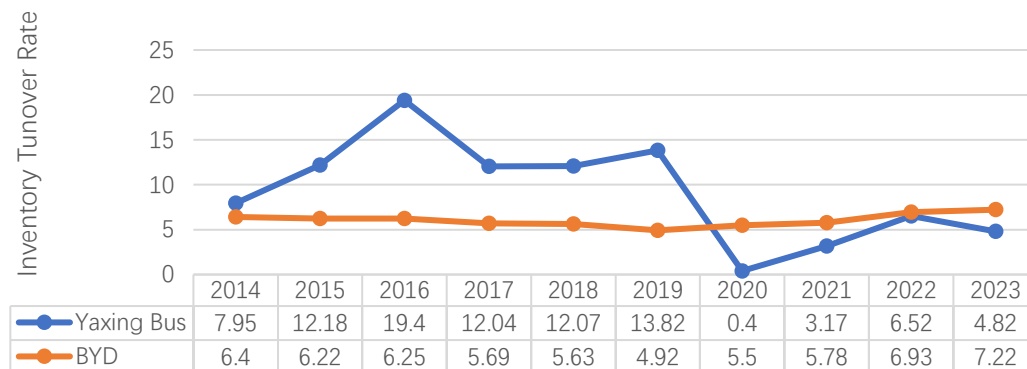


Figure 4. Comparison of inventory turnover rates between BYD and Yaxing Bus

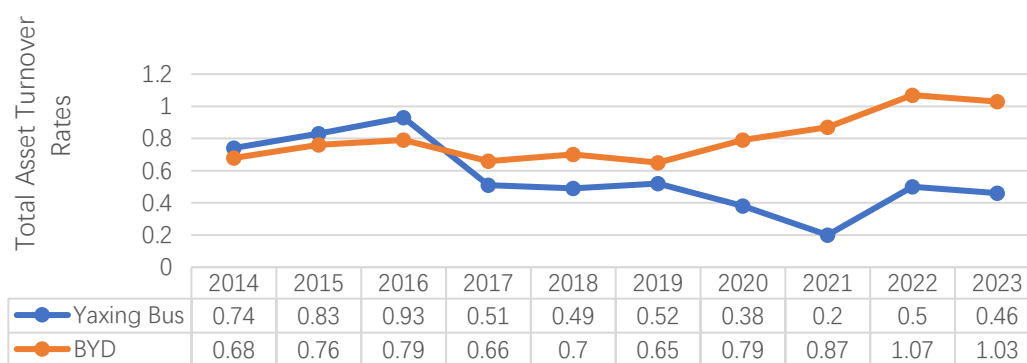


Figure 5. Comparison of Total Asset Turnover Rates between BYD and Yaxing Bus

7. Profitability analysis

7.1. Analysis of operating capacity indicators

Making a profit is one of the main goals of running a business. In order to survive and develop, companies must strive to earn higher profits so that they can be invincible in the competition. In this paper, two profitability indicators, Return on Assets and Net Profit Margin on Sales, are selected to analyze the profitability of Yaxing Bus, and Table 7 shows the data of Yaxing Bus's main profitability indicators from 2014 to 2023.

Return on Assets is the ratio of net profit to average total assets of an enterprise for a certain period of time, this indicator can comprehensively evaluate the profitability of an enterprise's assets, and it can reflect the asset allocation ability of the enterprise's managers. The higher this ratio is, the more profitable the business is. According to the data in Table 7, the Company continued to be profitable during the period 2015-2019, in which the large and medium-sized bus market improved in 2016 thanks to the rapid growth of large and medium-sized new energy buses coupled with the increase in demand for electrification in the bus and passenger transportation market, Yaxing Bus achieved a net profit of 62,307,800 RMB, and the net asset margin reached a historical high. After 2020, with the national subsidies for new energy vehicles regression, as well as the lack of competitiveness of their own products in the market, the bus market environment has changed considerably for other reasons, operating income declined, while the bus industry fixed costs remain high, Yaxing Bus continued to

lose money. The Return on Assets of Yaxing Bus is always low, the profitability of the enterprise's assets is weak, and the asset allocation ability of the enterprise's managers is poor, which indicates that the enterprise's operating efficiency is low, and there are problems in the management of the enterprise, so it should adjust the operating policy, strengthen the management of the operation, and improve the efficiency of the utilization of the assets.

Net Profit Margin on Sales illustrates the ratio of net profit to operating income, which evaluates a company's ability to earn profits through sales; the higher the ratio is, the stronger the company's ability is to obtain compensation through expanded sales. Yaxing Bus's operating income peaked in 2016, up 68.54% year-on-year. Although operating income fell back in 2017, the overall level of this figure remained in the 1.5-3.5 billion range. And after 2020, overall operating income is low and trending downward. In the 2015-2016 and 2017-2019 intervals, compared to the fast-growing operating income, the Net Profit Margin on Sales did not grow in tandem, but instead declined, reflecting the fact that Yaxing Bus increased its cost investment and expanded the scale of the enterprise during this period against the backdrop of a favorable market outlook. Since 2020, the Net Profit Margin on Sales of Yaxing Bus, in general, has continued to decline and become negative, the enterprise is in a loss-making position, the financial risk is high, and this situation is continuing to deteriorate, and the profitability of Yaxing Bus is weak. Upon analysis, the main reason came from the impact of the new Crown pneumonia epidemic on the bus industry. Along with the improvement of per capita income, people's travel mode gradually changed, and consumption upgraded to change the traditional mode of travel. At the same time, China's rail transit investment accelerated the development of urban and intercity rail transit. The superposition of the above factors led to a significant decline in China's road transportation passenger volume, a decline in demand for the bus market, and fierce competition in the industry, Yaxing Bus has less room for profit and weaker profitability.

Table.7. List of profitability indicators of Yaxing Bus (2014-2023)

Indicator Name /Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Return on Assets(%)	-6.69	0.65	1.78	1.12	0.31	0.28	-3.45	-0.47	-6.40	-12.84
Net Profit Margin on Sales(%)	-9.84	0.78	1.92	2.19	0.64	0.52	-8.51	-1.82	-13.09	-27.79

7.2. Comparison of profitability analysis in the same industry

The profitability of Yaxing Bus is a relevant indicator against the industry's leading enterprises BYD, Figure 6, and Figure 7 show the Yaxing Bus and BYDs' Return on Assets and Net Profit Margin on Sales respectively. Observing Figure 6 and Figure 7, it can be seen that from the trend, BYD's Return on Assets and Net Profit Margin on Sales show a gentle upward trend, while Yaxing Bus's shows a fluctuating downward trend, which can be deduced that compared with BYD, Yaxing Bus's profitability is weaker. Upon analysis, BYD's profitability trend over the past ten years (2014-2023) has been flat, less affected by the epidemic, market conditions, and policies, while Yaxing Bus's Return on Assets and Net Profit Margin on Sales have a greater range of change, poorer risk resistance, and weaker profitability.

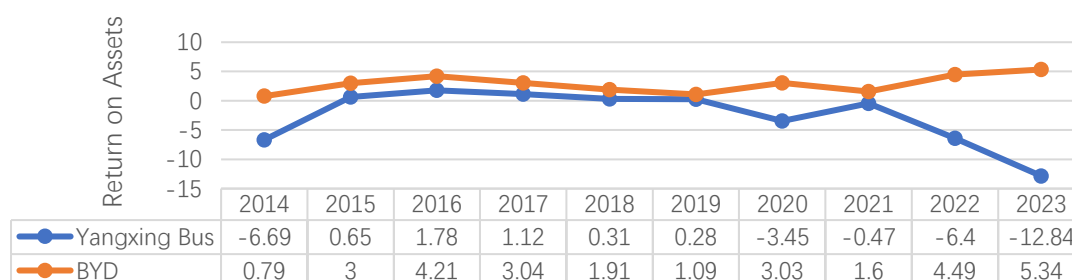


Figure 6. Comparison of return on assets of Yaxing Bus and BYD

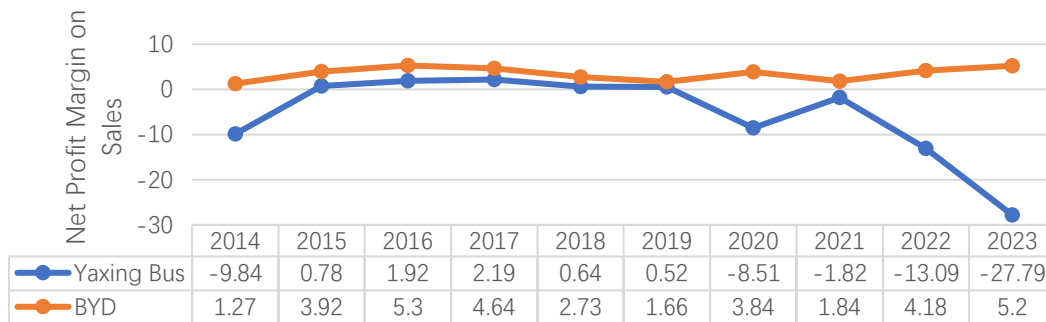


Figure 7. Comparison of net profit margin on sales of Yaxing Bus and BYD

8. Z-score calculation and analysis

8.1. Analysis of Yaxing Bus's Z-score

The Z-score model was applied to Yaxing Bus's financial indicators from 2014 to 2023, yielding results in Table 8. Analysis reveals that Yaxing Bus's Z-value remained below 1.81, indicating high financial risk and a significant bankruptcy probability. The Z-value declined from 2015 to 2022, suggesting escalating financial risks requiring mitigation.

Key financial fluctuations occurred between 2015-2016, 2019-2020, 2021-2022, and 2022-2023, with significant changes in X2 (profitability) and X4 (market value and liabilities). From 2014 to 2023, Yaxing Bus faced weak liquidity, poor profitability, and low operational efficiency. X4 was influenced by stock market value and liabilities, showing a decline due to increased production scale and liabilities in 2016, but rebounded post-2019. X5, indicating asset utilization efficiency, remained stable, suggesting moderate business operation effects.

Table.8. X-variable values and Z-scores under the Z-score model for Yaxing Bus (2014-2023)

Variant /Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
X1	0.07	0.09	0.02	0.32	0.36	0.20	0.16	0.16	0.22	0.07
X2	-0.24	-0.18	-0.09	-0.08	-0.07	-0.08	-0.13	-0.17	-0.26	-0.45
X3	-0.07	0.01	0.03	0.01	0.02	0.03	-0.01	0.02	-0.05	-0.13
X4	1.62	1.29	0.77	0.53	0.27	0.41	0.49	0.58	1.33	1.06
X5	0.80	0.75	0.73	0.51	0.47	0.55	0.45	0.31	0.53	0.51
Z	1.30	1.40	1.18	1.13	1.04	1.00	0.72	0.67	1.05	0.15

8.2. Analysis and comparison of Z-score situation of enterprises in the same industry

Based on the existing public data, a comparative analysis of the financial risk of Yaxing Bus and BYD in the recent five years (2019-2023) can be obtained in Table 9. According to the results, the Z-value of Yaxing Bus in the recent five years (2019-2023) was smaller than that of BYD, which indicated that Yaxing Bus was facing a greater financial risk and there was a greater probability of a financial crisis.

Table.9. Z-scores under the Z-score model for Yaxing Bus and BYD (2014-2023)

Company Name/Year	2019	2020	2021	2022	2023
Yaxing Bus	1.00	0.72	0.67	1.05	0.15
BYD	1.51	3.52	3.37	2.11	1.71

9. Conclusion

Yaxing Bus, as a representative of China's bus manufacturing industry, has experienced both success and decline. In its early years, it occupied a leading position through technological innovation

and market strategies. However, with policy changes, increasing competition, and poor management, it gradually lost its competitiveness. Its debt repayment ability has significantly weakened, bearing a particularly heavy long-term debt burden and weak short-term repayment capabilities. Operational capacity has declined, with low efficiency in accounts receivable and inventory turnover, and insufficient asset utilization. Profitability has continued to deteriorate, making it difficult to maintain market competitiveness and profit margins, while the new energy business has failed to stabilize the financial situation in the long term. The Z-score model indicates that the company faces bankruptcy risks, and compared to BYD, Yaxing Bus demonstrates clear deficiencies in financial management and market responsiveness.

10. Feasibility recommendations

Yaxing Bus should sell non-essential assets to improve cash flow and concentrate on core business. Seeking investors or partners can reduce debt and enhance competitiveness. Negotiating debt restructuring and considering debt-to-equity swaps can also lower financial costs. It also needs to manage receivables more effectively to speed up cash recovery and reduce inventory to free up funds. Implementing financial systems for risk management and exploring flexible financing options can improve cash flow. Finally, the company should shift focus to high-value new energy buses, aligning with government support. It should boost R&D in sustainable vehicles and expand both domestically and internationally, targeting markets like Europe for growth.

References

- [1] Huang Yongliang, Miao Wei. Research on the Development Path of the New Energy Vehicle Industry from a Financial Risk Perspective: Based on the Analysis of BYD's Financial Indicators[J]. Management and Business, 2022(07): 187-192.
- [2] Li Xueguang. Research on Financial Risk Identification and Response of S New Energy Vehicle Company[D]. Hebei University of Economics and Business, 2024.
- [3] Altman I Edward, Financial Ratios, Discriminant Analysis, and the Prediction of Corporate Bankruptcy [J]. Journal of Finance, 1968(09).
- [4] Cao Dongying. Research on Methods for Financial Crisis Early Warning and Analysis[J]. Journal of Hunan Environmental-Biological Polytechnic, 2011, 17(03): 31-34.
- [5] Cao Dan, Zhang Xiaolan, Zhang Qin, et al. Exploration of the Creation of Management Accounting Application Models for Small and Micro Enterprises[J]. Taxation, 2018(19): 107.
- [6] Guo Huanjun, Feng Yumei, Wang Xiuling. Application of Mathematical Methods in Management Accounting[J]. Business Research, 1999(05): 12-13.
- [7] Zhou Shouhua, Yang Jihua, Wang Ping. On Financial Crisis Early Warning Analysis: The F-Score Model[J]. Accounting Research, 1996(08): 8-11.
- [8] Bai Haobo. Financial Risk Assessment of Listed Companies Based on the Z-Score Model: Evidence from Luckin Coffee's Financial Data from 2017 to 2022[J]. China Market, 2024(14): 115-122.
- [9] Kang Caihong, Wang Qiuping, Xiao Yanting. Financial Early Warning of Listed Companies Based on an Improved FOA Algorithm for the Z-Score Model[J]. Computer Systems Applications, 2018, 27(11): 198-204.
- [10] Teng Xiyu, Li Shixin. Financial Risk Assessment of JK Culture Based on the Entropy Weight TOPSIS Method[J]. Journal of Hunan University of Science and Technology (Natural Science Edition), 2022, 37(03): 104-112.
- [11] Zhou Wei. Financial Data Risk Early Warning Method Based on the Random Forest Algorithm[J]. Journal of Xinxiang University, 2024, 41(06): 28-33.
- [12] Li Lujia. Financial Risks and Insights from the Transformation of Suning's Business Model[J]. Fujian Forum (Humanities and Social Sciences Edition), 2019(04): 48-56.