

# *JT Credit Risk Measurement Research*

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**Abstract:** Infrastructure construction is not only an important part of China's economic and social development, but also a strong support for the improvement of the well-being of people's livelihood. The 20th National Congress of the Communist Party of China proposes that my country should accelerate the construction of a modern infrastructure system and build a power of transportation. As a leading enterprise in China's transportation construction industry, JT Company is particularly important to do a good job in credit risk. Therefore, in order to reveal its credit status at this stage, this article calculates the Z value of 2018-2022 through the Z-Score model. And using the KMV model to measure the company's default distance from 2021-2022. The model measurement results show that the Z value of JT has continued to be lower than 1.8 in the past five years, and its debt repayment capacity, profitability and operating capacity have declined. In the eighth quarter, the trend of volatility was shown. From this, JT is currently facing a certain degree of credit risk. Therefore, in the future development path, measures such as establishing a risk indicator system, improving risk warning mechanisms, and flexibly using financial leverage can be taken for credit risk management.

## 1. Introduction

Infrastructure is an important support for economic and social development. It has a strategic, basic, and pioneering role. The construction of traffic infrastructure is an important part of it and the foundation of economic and social development. The rapid economic growth experience accompanied by the construction of large-scale infrastructure in the United States and Europe, as well as China's "economic growth miracle" all shows that transportation infrastructure has a significant role in economic drive (Banerjee, 2020)<sup>[1]</sup>. Not only that, the construction of transportation infrastructure also affects the regional industrial structure. For example, the opening of the high-speed rail has significantly promoted the upgrading of urban industrial structure (Sun Weizheng, etc., 2022)<sup>[2]</sup>. At the micro level, after reducing capital flow disorders, traffic infrastructure will introduce more foreign investment, confirming the existence of "siphon effects" (Ma Guangrong et al., 2020)<sup>[3]</sup>. The 20th National Congress of the Communist Party of China has further proposed to accelerate the construction of a "transportation power". As China's leading transportation infrastructure enterprise, its stable operation is of great significance to China's economic development. At present, the centennial change bureau and geopolitical intellectual overlay, the economic downlink pressure has increased, the asset-liability ratio of major infrastructure enterprises, the operating development status is not optimistic. Risk management for enterprises can reduce operational risks, minimize losses, and thus improve profitability. Credit risks have gradually become one of the important risks

in the development of enterprises. Measuring the credit risk of JT companies can urge enterprises to prevent risk prevention and have certain practical significance.

## 2. Literature review

Credit risk is one of the three important risks facing the financial industry. The measuring method of credit risk has also been a hot issue of academic circles. Among them, traditional credit risk measurement methods include expert analysis, rating method and scoring method. Before 1970, most financial institutions used experts to analyze the risk of credit, but this method was too subjective. The credit score rule is to calculate a numerical value to represent the credit risk of the debtor, and classify the borrower to different credit risk levels, which mainly include linear probability models, Logit models, profile models and linearity. Differential models, although this method can give the customer's credit risk level score, it cannot provide accurate value of customer default probability. The latter is often the most concerned by credit risk management, and the credit rating law can make up for this defect. It is based on it. In the past few decades, from the original classical analysis method to the modern measurement model, the credit risk measurement model has continued to evolve. The most used is the Z-Score model proposed by Altman (1968). The warning model subsequently revised and improved the original Z schedule model, increased the evaluation variables from 5 to 7 (Altman et al., 1977)<sup>[4]</sup>. Modern credit risk measurement models mainly include KMV models, CreditMetrics models, CreditportFolio View models, and Creditrisk+models. Among them, the CreditMetrics model measurement is based on the transfer of credit rating, including three key links: open, open value fluctuations and credit assets (Li Xingfa, etc., 2006)<sup>[5]</sup>. It mainly depends on historical data, affects the accuracy of the results, and is not forward-looking. Credit Risk+model is a credit risk measurement and combination management model launched by Credit Credit first Boston (CSFB) in 1997<sup>[6,7]</sup>. Its biggest advantage is simple and easy to use, but it ignores the change of credit levels only depends on the changes in long-term interest rates (Liang Shidong et al., 2002)<sup>[8]</sup>. CreditportFolio View model is a credit portfolio model developed by MCKINSEY in 1998. It considers the current macroeconomic environment and believes that the probability and probability of changes are associated with the economy. It is just the opposite when it improves, which also causes the model's coefficient to rely too much on the default data of the country and even the industry. The history of the KMV model can be traced back to the MERTON model of the 1870s. This model uses the idea of options pricing to determine the probability of breach of contract. It is a forward-looking and practical dynamic analysis model. In 1989, Kealhofer, MC Quown and Vasicek established KMV. In 2002, it was acquired by the world-renowned credit rating agency -Moody's acquisition. So far, the KMV model is still one of the most popular credit risk measurement tools in the financial industry and academic institutions. While using the company's historical measurement indicators, it focuses on the relevant information of the future development trend of the enterprise and effectively measures the credit risk. But it is only suitable for measuring the probability of the default of listed companies (Mc Quown, 1993)<sup>[9]</sup>.

In general, the measuring model of credit risk is mainly concentrated on Z-Score and KMV. In previous documents, the Z-Score model can be used horizontally in different enterprises in the same period, and it can also be compared vertically in the same period in different periods. The use of the KMV model is mainly focused on the measurement industry credit risk and local government bond defaults. Based on the KMV model, the credit status of my country's agricultural listed companies is relatively poor (Liu Yilin et al., 2014)<sup>[10]</sup>, the proportion of long-term liabilities in real estate companies is relatively high (Wang Hui et al., 2018)<sup>[11]</sup>, the scale of local government debt has increased (Xia Shiyuan, 2019)<sup>[12]</sup>, the risk of default in local areas is large, Qinghai, Guizhou and other local governments are actually "bankruptcy" (Liu Huiting, etc.)<sup>[13]</sup>. This article is different

from previous research to measure a single enterprise, which is more targeted.

### 3. JT company's basic situation

JT Company was founded on October 8, 2006. It was listed on the main board of the Hong Kong Joint Exchange on December 15th. It is China's first overall overall overall overall listing super-large state-owned infrastructure enterprise. In July 2008, JT was rated as Fortune 500 companies and was one of the most representative companies in China's construction industry. In December 2018, the JT company ranked in the "Belt and Road" top 100 Chinese companies. The main operations are ports, docks, channels, highways, bridges, bridges, railways, tunnels, municipalities and other infrastructure construction and real estate development. More than 75% of the share. The company is one of the old stores in many industries in China. It has more than 60 wholly-owned and holding subsidiaries, and its products and services cover more than 150 countries. The purpose of the JT company in the new era is: the person in charge of the government and economic and social development needs, actively participating in regional economic development, and making high-quality providers for government purchase of public services.

According to the annual report and other information disclosed by the company, from 2018 to 2022, the total operating income of JT Company increased by 229.403 billion yuan, and total assets increased by 550.874 billion yuan. Although revenue and assets continued to increase, their liabilities continued to grow. JT's total liabilities increased from 720.794 billion yuan in 2018 to 1085.174 billion yuan (see Figure 1).

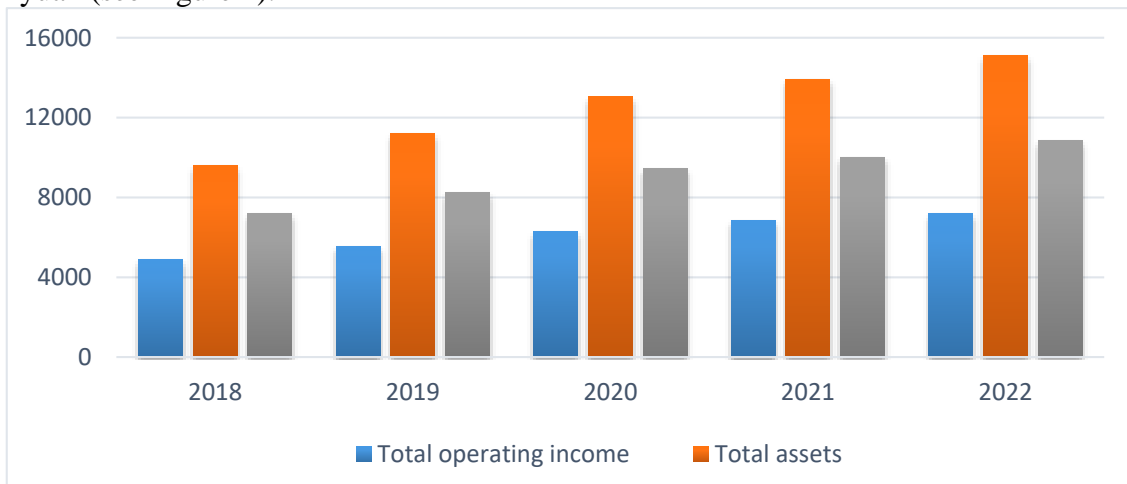


Figure 1: JT Company 2018 to 2022 Main financial indicators.

From the perspective of its composition of operating income in 2022, the infrastructure construction business accounted for the largest proportion, as high as 87.84%. The business achieved 80% of operating profit, and the gross profit margin was 10.61% (Figure 2). In the context of the probability and impact intensity of "black swan" and "gray rhinos", JT, as a leading company in infrastructure in China, is particularly critical to stabilize its status and control risks. Risk management can significantly suppress the loss of the stock value of the enterprise. For state-owned enterprises, the effects of risk management "bottom line" and "extended space" are more significant (Hu Mingxia, 2020) <sup>[14]</sup>.

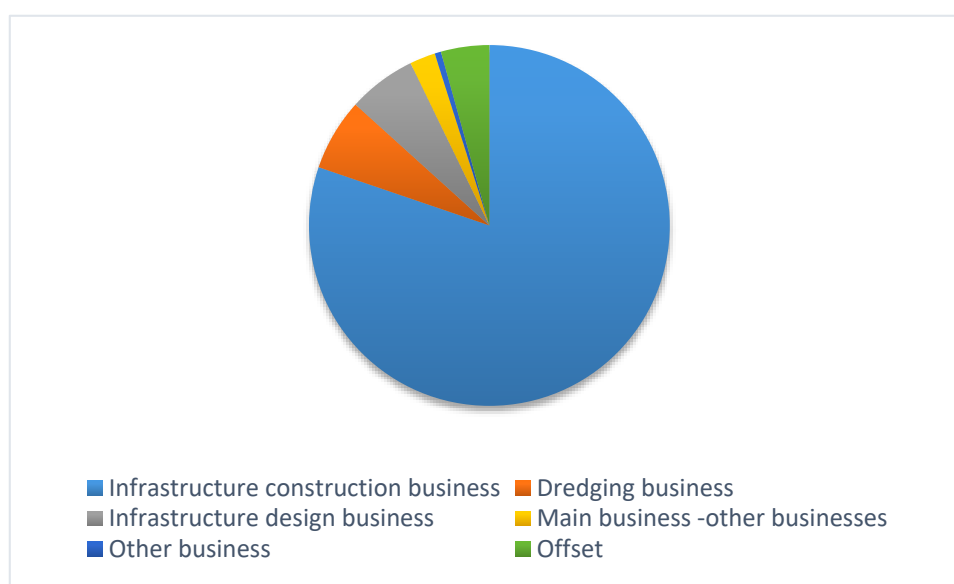


Figure 2: JT Company's operating income composition in 2022.

#### 4. JT company credit risk measurement

##### 4.1 Credit risk measurement based on the Z-Score model

The Z-Score model is different from the common single variable analysis method. This model is a multi-linear function based on the multi-variable statistical method, and through 5 basic financial ratios, it is an indicator reflecting the corporate debt capacity (X1,X4), the indicator of profitability (X2, X3) and the indicator of operating capabilities (X5), which is used to predict the probability of failure or failure of corporate financial failure.

According to the JT annual report and Wind database, the JT company's Z value data from 2018 to 2022 was compiled by calculation, as shown in Table 1.

Table 1: Z-Score model calculation result.

| index                      | 2018        | 2019        | 2020        | 2021        | 2022        |
|----------------------------|-------------|-------------|-------------|-------------|-------------|
| X <sub>1</sub>             | 0.17        | 0.25        | 0.14        | -2.29       | -2.98       |
| X <sub>2</sub>             | 12.07       | 12.01       | 11.15       | 11.42       | 11.44       |
| X <sub>3</sub>             | 3.21        | 2.86        | 2.39        | 2.34        | 1.99        |
| X <sub>4</sub>             | 25.27       | 17.98       | 12.40       | 13.88       | 11.99       |
| X <sub>5</sub>             | 51.11       | 49.52       | 48.12       | 49.30       | 47.66       |
| Z value                    | 0.94        | 0.87        | 0.79        | 0.79        | 0.74        |
| Z value result description | Worry -free | Worry -free | Worry -free | Worry -free | Worry -free |

According to the results, JT's Z value was lower than 1.8 from 2018 to 2022, and it showed a gradual decline. The company's financial situation was "worrying." From a single indicator, the X<sub>1</sub> indicator has declined year by year, and negative values occurred in 2021 and 2022, indicating that the mobile liabilities of JT companies are higher than mobile assets, and the pressure of short-term debt repayment increases. After three years of decline, the X<sub>2</sub> indicator began to return gradually, especially in the first year after the epidemic, the company resumed work and production, the profit gradually accumulated, and the ability to pay dividends increased. The X<sub>3</sub> indicator shows that although JT has a certain competitive advantage and market position in the industry, its profitability

has weakened year by year. The smaller the  $X_4$  indicator, the greater the total liabilities of JT companies, and the increase in financial risks of the company. The  $X_5$  indicator shows that the asset turnover rate of JT is declining, which further affects the profitability of enterprises.

In general, the financial ratio of the Z-Score model reflects the decline of JT's debt repayment capacity, profitability and operating capacity. In the past, the extensive development model of debt-based development and profit-scale extension was prevailed. Now deleveraging is an important part of the supply-side reform. In such an industry background, although JT does not have substantial risks, it still hides greater risks.

## 4.2 Credit risk measurement based on KMV model

When using the KMV model to analyze the credit risk of JT, the stock value volatility and equity value must be calculated first, and then the KMV model is used to calculate the breach of contract and the breach of contract.

### 4.2.1 Calculate equity value and equity volatility rate

This article uses Matlab to calculate the equity value and stock price volatility of JT Company from the first quarter of 2021 to the fourth quarter of 2022 (see Table 2), and compare the daily and quarterly volatility of JT Company with ZT Company, and observe the specific situation of JT Company's stock price changes (see Figure 3).

Table 2: 2021-2022 JT Company's equity value and equity volatility rate.

| time   | Closing price (Yuan/share) | Total share capital (100 million shares) | Equity value RMB100mn | Daily volatility | Seasonal volatility |
|--------|----------------------------|--|-----------------------|------------------|---------------------|
| 2021Q1 | 6.73                       | 161.66                                   | 1087.97               | 1.53%            | 11.54%              |
| 2021Q2 | 6.48                       | 161.66                                   | 1047.56               | 0.71%            | 5.49%               |
| 2021Q3 | 7.21                       | 161.66                                   | 1165.57               | 2.78%            | 22.42%              |
| 2021Q4 | 7.49                       | 161.66                                   | 1210.83               | 2.02%            | 15.88%              |
| 2022Q1 | 9.34                       | 161.66                                   | 1509.90               | 3.65%            | 27.80%              |
| 2022Q2 | 9.52                       | 161.66                                   | 1539.00               | 2.73%            | 20.95%              |
| 2022Q3 | 8.16                       | 161.66                                   | 1319.15               | 1.68%            | 13.51%              |
| 2022Q4 | 7.86                       | 161.66                                   | 1270.65               | 3.06%            | 23.67%              |

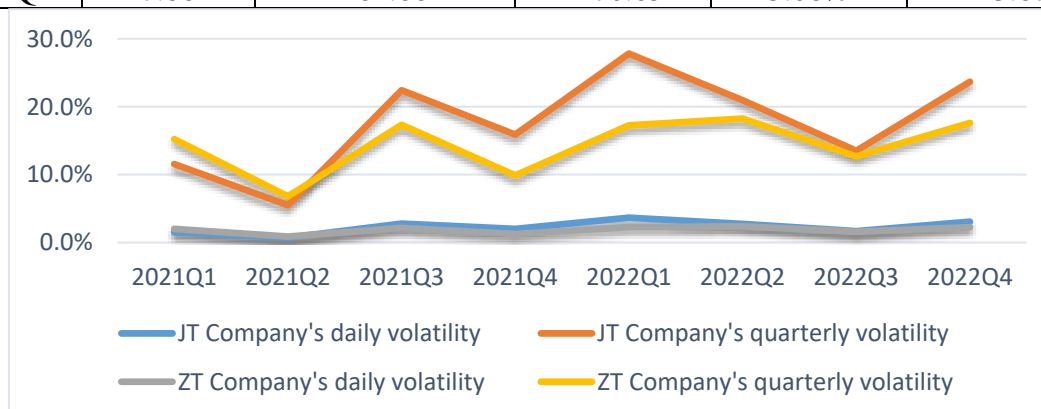


Figure 3: Daily and quarterly volatility of JT and ZT companies from 2021 to 2022.

According to the data, there is a certain difference between the daily and quarterly volatility trends of stock values for both JT and ZT companies. Overall, the fluctuation amplitude of daily volatility is smaller than that of quarterly volatility. At the same time, both JT Company and ZT Company are

large infrastructure enterprises in China. However, in terms of daily and quarterly volatility, JT Company's stock prices fluctuate relatively violently, indicating that its stability needs further improvement.

#### 4.2.2 Calculate the value of company assets and the volatility of asset values

This article uses Matlab to calculate the asset value and volatility of JT Company, and compares it with the trend of ZT Company's changes. The results are shown in Figure 4.

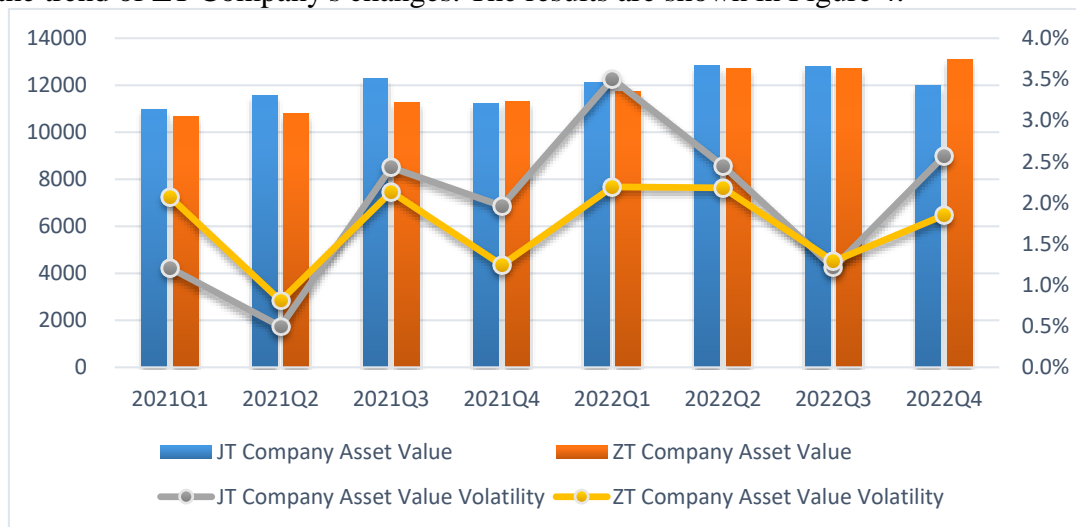


Figure 4: Fluctuations in Asset Values of JT Company and ZT Company from 2021 to 2022.

According to data, JT Company's asset value was generally higher than ZT Company before the fourth quarter of 2022, but its asset value volatility was greater than ZT Company, indicating that JT Company's asset value volatility was more severe.

#### 4.2.3 Calculate the default point DPT and default distance DD

Using Matlab, calculate the DPT and DD values of JT Company from Q1 2021 to Q4 2022 (as shown in Figure 5).

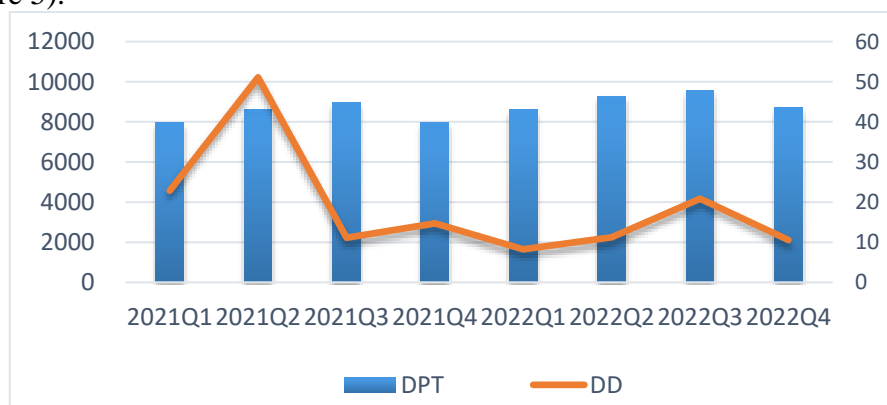


Figure 5: Changes in DPT and DD of JT Company from 2021 to 2022.

From Figure 5, it can be seen that JT Company's default distance decreased from 22.83 in the first quarter of 2021 to 8.25 in the first quarter of 2022, and the default risk gradually increased. Subsequently, the default distance slowly expanded to 10.58 in the fourth quarter of 2022. From the current measurement results of default distance, JT Company's default probability is relatively low.

## 5. Inspiration

Based on the conclusion of JT Company's credit risk measurement, this article provides the following five suggestions for its potential credit risk: One is that enterprises can establish a risk indicator system, improve internal indicators, and implement full process risk monitoring and management for projects. The second is to improve the risk warning mechanism, increase investment in macro environmental monitoring, make good use of information technology, introduce a risk warning system suitable for the company's situation, and focus on combining industry trends to conduct scientific risk prediction and analysis, in order to prevent potential risks at any time. The third is to flexibly use financial leverage, appropriately reduce interest bearing liabilities, and lower the interest per share of borrowing; At the same time, reasonable tax avoidance should be carried out by hiring senior professional and technical personnel in accounting, taxation, law, and other fields to carry out sufficient tax planning. The fourth is to closely track rating reports, increase the quantification ratio of third-party rating agencies, introduce quantitative models, and focus on factors that may trigger rating downgrades, and adjust corporate strategies in a timely manner. The fifth is to operate the company reasonably and steadily, and establish a debt repayment guarantee mechanism for the company.

## 6. Conclusion

According to the measurement results of the Z-Score model and KMV model, JT Company's debt paying ability, profitability, and operating ability have all shown a downward trend. Affected by the COVID-19 in 2020, the Z value of JT Company dropped the fastest, but after the resumption of production, the Z value did not return to the level before the epidemic. The main reason is that infrastructure enterprises generally have the characteristics of long project duration, slow fund withdrawal and high leverage ratio. However, it cannot be ignored that JT Company's Z-value has been consistently below 1.8 in recent years, indicating that the Z-Score model is used to measure JT Company's credit risk, which needs to be taken seriously by the management. From the perspective of the KMV model, the default distance of JT Company in the eight quarters of 2021-2022 has shown a fluctuating downward trend, and the default distance of JT Company in the fourth quarter of 2022 has decreased by half compared to the first quarter of 2021. Although JT Company has not experienced substantial default at present, combined with the Z-Score model, the measurement results of the KMV model show a similar trend to the Z-value. Both credit risk measurement models reflect the increasing trend of JT Company's credit risk year by year. In the future, JT Company should identify the root causes of potential credit risks from multiple aspects and perspectives, and do a good job in risk management.

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