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Empirical Analysis of Default Risk in High-Tech Enterprises Using the KMV Model on the Growth Enterprise Market

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Abstract:

Given the default risk faced by enterprises, this study employs the KMV model to conduct an empirical analysis utilizing market data from technology-based firms listed on the main board and the Growth Enterprise Market (GEM). It calculates the distance to default and the probability of default for technology-based companies of various sizes. Following this, a sensitivity analysis is performed to examine the impact of different factors on default risk. Based on the empirical findings, the study offers recommendations for the financing system and risk management strategies pertinent to the government, financial institutions, and enterprises.

Keywords:

Growth Enterprise Market; Technology Enterprises; Default Risk; KMV Model.

1. Introduction

Under the situation of reshaping the international economic structure and increasing downward pressure on the domestic economy, the development of high-tech enterprises has been promoted as a national strategy, bearing the important task of a new round of economic growth.On October 30, 2009, China officially launched the growth enterprise market to help small and medium-sized enterprises, high-tech enterprises and innovative enterprises further broaden financing channels, increase the availability of loans and solve financing difficulties.For more than ten years, gem has helped high growth technology-based enterprises to improve the availability of loans, and has gradually become the main object of credit business of commercial banks.However, most of the technology-based enterprises listed on GEM are in the early stage of development, with relatively small scale and poor ability to resist risks; gem has not established a relatively perfect financial evaluation system, which can not predict the potentialoperational and financial risks, and it is easy to lead to the occurrence of default events and fallinto the vicious circle of financing difficulties again. Therefore, it is important to study the default risk of gem technology-based enterprises from the perspective of scale, compare with the main board technology-based enterprises, and consider the influencing factors of default risk from the perspective of industry, government, financial institutions and enterprises themselves.

Scholars at home and abroad have done extensive empirical research on the measurement of default distance and default risk of listed companies, as well as the main factors affecting default risk.KMV model is widely used to evaluate the default risk of enterprises.Yang Xiuyun comparesthe credit risk measurement model of No.4 Middle School, which is currently usedinternationally, and thinks that KMV model is the most suitable model in China's financial market environment [1].Domestic scholars mainly use KMV model to measure the creditdefault risk of financial institutions and listed companies and the default probability of government bonds. Ling Jianghuai and Liu Yanmei use KMV model to evaluate the risk of commercial banks and quantify the overdue default rate of commercial banks [2].From the perspective of interest rate marketization, Chen Xiaochen uses KMV model to analyze the mechanism and degree of the impact of interest rate fluctuation on the default risk of commercial banks [3]. Hu Xinying divided the industries to which the enterprises belong, and evaluated the credit risk of Listed Companies in manufacturing and construction

industries by KMV model [4]. Yang Zhuqing combines innovation with default and empirically studies the relationship between R & D innovation investment and default risk of listed companies based on KMV model [5]. From the perspective of regional finance, Zhang Binbin analyzed the differences of financial default risk in different economic regions by constructing KMV and spatial Durbin model [6]. Yao Peng and potential used KMV model to predict the expected default probability of local government special bonds, and discussed the issue and payment sustainability of special bonds [7].Y. Through empirical analysis, dendramis and tzavalis proved that the disorder of financial market supervision mechanism is the main factor causing the increase of credit risk of Listed Companies [8].Leoraklapper believes that private enterprises use insurance to transfer their own credit risk to buyers with better risk resistance ability, and alleviate the problems of information asymmetry [9].In terms of model revision, domestic scholars have revised the estimation models of asset value, asset value volatility and equity value volatility, and the empirical results show that the revised model has better accuracy and sensitivity [10].Foreign scholars improve the parameter setting of KMV model through optimization algorithm.Lee proposed an improved ga-kmv model combined with genetic algorithm to improve the calculation accuracy of default point and default probability [11].

To sum up, scholars at home and abroad have made more mature improvements and widely used KMV model.However, from the perspective of industry and scale, the KMV model is less used to compare the default risk of technology-based enterprises with different scales.In view of this, this paper selects the panel data of 10 technology-based leading enterprises listed on the main board and 15 growth technology-based enterprises listed on the gem from 2015 to 2019, uses KMV model to measure the default point and default probability of enterprises, and evaluates the default risk of enterprises.At the same time, through the establishment of multiple regression model, the sensitivity of each parameter was analyzed.Finally, from the perspective of the government, financial institutions and enterprises themselves, practical suggestions are given to reduce the default risk.

2. Construction and empirical analysis of KMV model

2.1. Research ideas

The main idea of KMV model is that, given the company's liabilities, the market value of the debtor's assets determines the default risk of the loan.Through the construction of KMV model, we can effectively use the public information of the financial market, quantify the default distance of listed companies, and predict the default probability of the company in the future.

Firstly, according to BSM option pricing theory, the market value of assets in KMV model is calculated (V_a) And asset value volatility (σ_a) It is calculated by the following equations:

$$\begin{cases} E = V_a N(d_1) - De^{-rT} N(d_2) \\ d_1 = \dfrac{\ln\left(\frac{V_a}{D}\right) + (r + 0.5\sigma_a{}^2)T}{\sigma_a\sqrt{T}} \\ d_2 = d_1 - \sigma_a\sqrt{T} \\ \sigma_E = \dfrac{N(d_1)V_a\sigma_a}{E} \end{cases}$$

1.The debt maturity t is set at 1 year, that is:

2.The risk-free interest rate is the one-year lump sum deposit and withdrawal rate announcedby the people's Bank of China.

3.The default point is set at the position of short-term liabilities plus half of long-term liabilities,that is:

4.The historical volatility method is used to calculate the volatility of the company’s equity value:Among for the first time the closing price of a trading day. Then get the annual volatility of equity value ， Is the number of trading days in a year, set to 250.

2.2. Sample selection and data preprocessing

In order to achieve the research purpose of comparing the default risk of technology-based

enterprises of different sizes, this paper selects 10 main board listed technology-based enterprises and 15 GEM listed technology-based enterprises as the research objects by referring to the listing time, company size, main business and Baidu search frequency of the company. According to the indicators involved in the KMV model, the research period of the sample is determined as January 1, 2015 to December 31, 2019.The data comes from the wind database and the financial statements of various companies.Because the initial dimension of the original data of each parameter is different, this paper first carries out the data standardization, and then solves it with the help of MATLAB software.

3. Sensitivity analysis

In this paper, KMV model is used to quantify the default distance and default risk of different scale technology enterprises. According to the stock information of financial market, the default probability is closely related to the parameters of KMV model.Therefore, in the sensitivity analysis of default probability parameters, this paper refers to the five indicators of equity value, volatility of equity value, asset value, volatility of asset value and default point [12] adopted by Bai Xueyi, and uses Eviews software to establish the multiple regression model of the above five variables, and further analyzes the influence of each parameter on the default distance and default probability.

3.1. Variables and sample selection

The probability of default is taken as the explained variable Y, asset value (X_1) Asset value volatility (X_2) Equity value (X_3) Equity value volatility (X_4) Default point (X_5) As an explanatory variable. The selected samples are still the objects of the previous study, including 10 main board technology-based enterprises and 15 gem technology-based enterprises.

3.2. Modeling

The following multiple linear regression model was established

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon$$

Among them, α Is the intercept term, β_1, β_2, β_3, β_4, β_5 Is the regression coefficient of each parameter, ε Is the error term.

3.3. Regression results

Stepwise regression method was used for regression analysis, and the regression results were obtained, as shown in Table 2.

Table 2. Model statistics

R2	Adjusted R2	F value	P value
0.8359	0.8061	97.3063	0.0000

The significance test results of the equation are as follows F=97.3063, The P value is 0, less than0.05, indicating that the overall significance of the regression equation is good, and there is a significant linear relationship between the explanatory variables and the explained variables. R^2=0.8359, indicating that the fitting degree of the equation is good.

Parameters test results: at the significance level of 5%, X_1, X_2, X_3, X_5 The statistics of the model are - 13.2242, - 4.6718, - 13.8573, - 11.3437, and the absolute values are greater than 1.987. It is considered that the asset value, equity value, equity value volatility and default point in the model have passed the significance test, which has a significant impact on the default probability of the explained variable.

Finally, the regression equation is as follows

$$Y = 4.2981 + 0.0417X_1 - 0.4328X_2 - 0.0491X_3 - 0.3629X_4 - 0.0546X_5$$

3.4. Result analysis

From the positive and negative sign of the parameter coefficient, asset value is positively correlated with default probability, while asset value volatility, equity value volatility and default point are negatively correlated with default probability.From the change of indicators, the probability of default will increase by 0.0417% when the asset value increases by 1%, and the probability of default will decrease by 0.4328% when the asset value volatility increases by1%. It shows that the impact of asset value volatility is greater than asset value.Therefore, enterprises should strengthen management to reduce the volatility of asset value, so as to reduce the probability of default.Among the other three parameters, the degree of impact on the probability of default from large to small is the volatility of equity value, default point and equity value.To a certain extent, the fluctuation of stock price reflects the stability of asset valueand the situation of company management, which plays an important role in the evaluation andearly warning of company credit risk.

4. Conclusions And Suggestions

4.1. Conclusions

Based on the perspective of industry and scale, this paper selects 10 main board technology- based enterprises and 15 gem technology-based enterprises as samples, and uses KMV model to measure the default distance and default probability of enterprises in each year from 2015 to 2019 according to financial market information such as equity value and debt face value.By analyzing the default risk of technology-based enterprises as a whole, comparing the default risk of different scale technology-based enterprises, and sensitivity analysis of asset value and other parameters, the following conclusions are drawn.

First of all, most of the technology-based enterprises are in the initial stage of development, andbased on high-tech business, which has certain operational risks.However, with the support of national policies and the role of market mechanism, the default risk of technology-based enterprises is decreasing year by year, and the default probability can be maintained in a relatively low range under the influence of emergency factors, which has a good development prospect.Secondly, the default risk of technology-based enterprises with different scales is different.The technology-based leading enterprises listed on the main board have high asset value, low default probability, small fluctuation and low credit risk.For the technology-based enterprises listed on GEM, the asset value is relatively low, the probability of default is relativelyhigh and the degree of fluctuation is greater, and the influence of external factors is more likely to lead to the occurrence of default events.Finally, taking asset value, asset value volatility, equity value, equity value volatility, default point as explanatory variables and default probability as explained variables, we can find that equity value volatility and asset value volatility have a greater impact on default probability.Therefore, optimizing the capital structure and stabilizing the operating conditions play an important role in reducing the defaultrisk.

4.2. Suggestions

According to the results of the above empirical analysis, this paper will put forward suggestions to reduce the default risk and promote the financing virtuous cycle from the three aspects of the government, financial institutions and enterprises themselves.

First of all, while formulating a series of policies to encourage scientific and technological research and development and strengthen financial support, government departments should further standardize market supervision and strengthen information disclosure.GEM listed companies in the financial information audit is relatively weak, there are many problems in information disclosure, to a certain extent, affect the authenticity and accuracy of credit risk assessment.Therefore, the government regulatory departments should strengthen the constraints on enterprises, use big data, blockchain and other information technology to establish an electronic information disclosure system, and build a more real and effective financial market.

Secondly, financial institutions should establish a multi angle comprehensive credit evaluation system.When making loan decisions, financial institutions need to consider the credit status of enterprises, but it is not comprehensive to only refer to the results predicted by the model.Financial institutions need to integrate the industry and scale of the enterprise, the authenticity of relevant

data sources and the impact of various emergencies, pay attention to the industry risk, industry boom changes and the development prospect of the enterprise, and establish a credit evaluation scheme combining qualitative judgment and quantitative analysis.

Finally, enterprises themselves need to establish a good sense of credit and risk awareness. By increasing the value of assets and reducing the fluctuation of stock price, enterprises can improve their credit rating and strengthen their ability to resist risks, so as to reduce the occurrence of financial crisis and effectively avoid the risk of default.At the same time, the enterprise should establish a standardized risk management department, establish a real and complete credit evaluation system, and effectively deal with the default risk caused by variousunexpected factors.

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