The ways to calculate distance to default based on KMV model derivation

Dandan Zhou [1,a], Fuwei Li [1,b], Jie Gao [1, c]

School of Economics and Management, Chongqing University of Posts and Telecommunications, Chongqing 400065, China.

[a]dandan.j.zhou@qq.com, [b]fuwei901@gmail.com, [c]JessicaG24@163.com

Abstract

This paper describes the basic idea of KMV and re-derives the relevant mathematical equations in the model, realizing the practical application of KMV model, and calculating the default distance of 523 enterprises in manufacturing. At last, it provides a theoretical basis for improving the efficiency of enterprise risk management.

Keywords

KMV Model, Option Pricing Model , Mathematical Derivation ,the Distance to Default.

1. Introduction

The default distance method is based on the "Black-Scholes-Merton" option pricing model[1], developed by KMV credit rating company into the KMV credit rating method; In 2000, KMV was acquired by Moody's, one of the world's three major rating agencies, forming Moody's KMV rating method[2]. KMV model regards the company's shareholders' equity, that is, the equity value as a call option based on the market value of the enterprise's assets, with the total liabilities as the execution price. When the market value of the enterprise assets is less than the total liabilities, the enterprise will face the default risk of not being able to repay the loan. In the KMV model, the default distance DD is used to quantify the credit risk of the enterprise[3]. The greater the default distance, the lower the credit risk[4]. The default distance is used as a credit risk measure, and its robustness is widely used in rating practice[5]. The core of the KMV credit rating method is the default distance (DD) credit metric, which is based on dynamic data in the real market, determined by asset market value, asset market value volatility, equity value, equity value volatility, and default points.

2. Theoretical basis and model

2.1 The basic idea of KMV model

When the market value V_A of the enterprise asset is less than the total debt D of the enterprise, the enterprise will face the risk of not being able to repay the loan, which is called the enterprise default. In the KMV model, the default distance DD is used to indicate the value of the asset market value V_A from the point of default DP ,thus reflecting the possibility of default. The greater the default distance, the less likely the company will default. On the contrary, the smaller the default distance, the more likely the company will default. The steps to calculate the default distance are as follows:

Firstly, the asset market value V_A^0 and volatility δ_V are solved, but they cannot be directly obtained, they need to be obtained by the relationship between the equity market value E , the equity market value volatility δ_E and the debt amount D .The simultaneous equations are solved as follows:

$$\begin{cases} E = V_A^0 N(d_1) - De^{-rT} N(d_2) \\ d_1 = \dfrac{\ln(\frac{V_A^0}{D}) + (r + \frac{\delta^2}{2}) * T}{\delta\sqrt{T}} \\ d_2 = d_1 - \delta\sqrt{T} \end{cases} \quad (1)$$

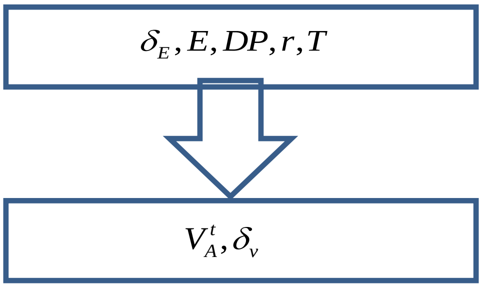
$$\delta_E = \frac{V_A^0 \delta_V}{E} N(d_1) \quad (2)$$

After obtaining the market value V_A^0 and volatility of the asset δ_V , the default distance can be obtained according to the definition of the default distance DD . The expression is as follows[1, 6, 7]:

$$DD = \frac{V_A^t - DP}{V_A^t \delta_v} \quad (3)$$

V_A^t is the market value of the asset at the time of maturity (ie $T = t$) of the corporate debt, but this paper assumes that the growth ratio of the corporate asset during the liability period is 0[2], that is, the calculation V_A^t of the default distance is the above-mentioned V_A^0 .The point of default DP is a value between current liabilities and total liabilities, and the mathematical form is $DP = SD + 0.5 * LD$. SD is the short-term debt at the end of the business, and LD is long-term debt. This paper assumes that the company only has a single interest-free debt, the amount of debt [8]here is DP .

2.2 The solution of related parameters of KMV model



(1) The calculation of stock volatility δ_E

The traditional method of calculating stock volatility is to use historical stock price data to solve the problem. The specific solution formula is as follows: $u_i = \ln(\frac{S_i}{S_{i-1}})$. u_i is the stock daily return rate, and S_i is the stock closing price after the end of the first time interval. According to the definition of stock volatility, calculate the standard deviation of stock daily yield, and obtain daily volatility:

$$S = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(u_i - \bar{u})} \quad (4)$$

Obtained the daily volatility, and assume that the annual stock trading day is about 240 days, $\delta_E = S * \sqrt{240}$ the annualized volatility is obtained. However, a large number of literatures show that the changes in stock returns are clustered in volatility[9]. The so-called volatility clustering means that the fluctuation of the long-term financial time series in a certain period of time often shows a situation of continuous high or low, that is, the random disturbance is followed by a large amplitude fluctuation followed by a large fluctuation, which is smaller. Amplitude fluctuations are followed by small fluctuations, a phenomenon known as volatility clustering. However, the above method has obtained a phenomenon that the stock volatility and the actual situation are not consistent. Therefore, the GARCH (1,1) model is used to calculate the stock volatility. In this case, the volatility obtained is closer reality.

The concrete expression of the GARCH(1,1) model is as follows:

$$\text{Mean equation:}\quad y_t = c + \varepsilon_t, \varepsilon_t \sim N(0, \delta_t^2) \tag{5}$$

$$\text{Conditional variance equation: } \delta_t^2 = \gamma V_L + \alpha\varepsilon_{t-1}^2 + \beta\delta_{t-1}^2 \tag{6}$$

Replace ω with γV_L, to become the following equation:

$$\delta_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\delta_{t-1}^2 \tag{7}$$

δ_t^2 :The predicted variance of the t-th period is called the GARCH item;

ε_{t-1}^2 : The square of the residual of the t-1th period, the random disturbance term, is called the ARCH term.

V_L : Long-term average variance;

$\gamma, \omega, \alpha, \beta$:Weights are greater than 0, and $\gamma + \alpha + \beta = 1$

GARCH(1,1) is called generalized autoregressive conditional heteroskedasticity. In this case, the stock daily volatility is not a fixed constant, but varies from time to time. The first "1" in brackets represents the number of items in the GARCH item, the GARCH item is the influence of the previous prediction variance on the current variance; the second "1" represents the number of items in the ARCH item, and the ARCH item is called the random disturbance item, which is a amount of change over time is measured by the volatility of the previous period. The meaning of "autoregressive" here is the introduction of values of some order of the explanatory variables such as δ_{t-1}^2 . As an explanatory variable, explaining the change of the variable together with the random disturbance term. That is, the regression that introduces the regression variable itself is called autoregression. “Iterovariance” refers to the regression model, the variance between the random disturbances ε is different. So the construction of the GARCH model is to eliminate this heteroscedasticity as much as possible.

Suppose that it obeys a mean of 0 and the variance is δ_t^2 , and this variance is a linear combination of the square of the lag of its random disturbance term, called the conditional variance. After fitting the GARCH(1,1) model with the enterprise data, the daily volatility of the company's stock return rate is obtained, assuming that the trading day of the year is 240 days, and then converted into the annualized volatility of the calculation base date.

(2) Calculation of equity market value

It should be noted that when calculating the equity market value of listed companies, if the price difference between the tradable shares and the non-tradable shares caused by the split of the listed companies in China is not considered, the market price of the tradable shares is multiplied by the total share capital to estimate the equity of the company. The market value may underestimate the credit risk of the enterprise; in the special market environment in which Chinese listed companies are located, the setting of the default point coefficient may affect the model prediction ability. Therefore, combined with the specific situation of China's stock market, the value of the equity market is composed of two parts, namely the market value of the tradable shares and the market value of the non-tradable shares. The specific calculation expression is as follows:

Equity market value = market value of tradable shares + market value of non-tradable shares = average closing price of stock weekly in the current day of the benchmark day * the number of tradable shares+the number of non-tradable shares * net assets /per share

(3) The point of default DP, r and T

The point of default $DP = SD + a * LD$, a is the coefficient, which reflects the influence of the long-term liabilities of the enterprise in the default of the enterprise. The larger a is, the higher the proportion of long-term debts in corporate defaults. A large number of literatures[10, 11]have verified that 0.5 can reflect the true default of the company to a greater extent, so this paper takes 0.5.

r is the annual return on assets, it is also called a risk-free rate. This paper sets the one-year time deposit rate announced by the People's Bank of China on the base date. T is 1 quarter.

3. Derivation of theoretical formulas related to KMV model

（1） Black-Scholes option pricing theory

KMV model is based on the Black-Scholes option [1]pricing theory. The options are divided into European options and American options. The famous scholars Black and Scholes's study are based on European options, and the rules can only be exercised on the expiration date.

The basic assumptions of Black-Scholes option pricing theory are as follows:

1) The change in stock price is subject to a lognormal distribution;

2) The risk-free rate is fixed throughout the exercise period;

3) Assume that there is no transaction cost in the securities transaction and there is no dividend distribution.

Based on the above assumptions, Black and Scholes proposed a pricing model for bullish (put) options as follows:

$$\begin{aligned} &Call(S,K,r,T,\delta) = SN(d_1) - Ke^{-rT}N(d_2) \\ &Put(S,K,r,T,\delta) = Ke^{-rT}N(-d_2) - SN(-d_1) \\ &d_1 = \frac{\ln(\frac{S}{K}) + (r + \frac{1}{2}\delta^2)T}{\delta\sqrt{T}} \\ &d_2 = d_1 - \delta\sqrt{T} \end{aligned} \quad (8)$$

S is the price of the stock at the time; K is the strike price of the option; r is the risk-free interest rate; r is the volatility of the stock's return; T is the maturity date of the held option.

（2）Itō's lemma

G is a function of V and t , and must satisfy the following equation:

$$\begin{aligned} d_G &= (\frac{\partial G}{\partial V} * \mu V + \frac{\partial G}{\partial t} + \frac{1}{2}\frac{\partial^2 G}{\partial V^2}\delta^2 V^2)d_t + \frac{\partial G}{\partial V}\delta V d_Z \\ &= (\mu - \frac{1}{2}\delta^2)d_t + \delta d_Z \end{aligned} \quad (9)$$

(3) Derivation of the property of lognormal distribution

1) Meaning: Assume that the value of financial assets V obeys a lognormal distribution, that is $\ln V$ obeys a normal distribution.

2) Derivation: $\ln V_T \sim N[\ln V_0 + (\mu - \frac{\delta^2}{2})T, \delta^2 T]$

Let $G = \ln V$, G is a function of V and t, and $\frac{\partial G}{\partial V} = \frac{1}{V}, \frac{\partial^2 G}{\partial V^2} = -\frac{1}{V^2}, \frac{\partial G}{\partial t} = 0$. Therefore, based on formula Itō's lemma, the function G with V and t obeys:

$$d_G = (\frac{\partial G}{\partial V} * \mu V + \frac{\partial G}{\partial t} + \frac{1}{2}\frac{\partial^2 G}{\partial V^2}\delta^2 V^2)d_t + \frac{\partial G}{\partial V}\delta V d_Z$$
$$= (\mu - \frac{1}{2}\delta^2)d_t + \delta d_Z \quad (10)$$

This shows that $G = \ln V$ is a generalized Wiener process that satisfies a drift rate $\mu - \frac{1}{2}\delta^2$ and a variance rate δ^2. That is, $\ln V$ -the change between the times $0 \sim T$ obeys the mean $(\mu - \frac{1}{2}\delta^2)T$ and the normal distribution of variance is $\delta^2 T$ .Then $\ln V_T - \ln V_0 \sim N[(\mu - \frac{\delta^2}{2})T, \delta^2 T]$,got it $\ln V_T \sim N[\ln V_0 + (\mu - \frac{\delta^2}{2})T, \delta^2 T]$. μ is the annual rate of return on the value of financial assets; δ is the volatility of the return on financial assets.

(4) Black-Scholes-Merton Debt Pricing Model

1) Thought

The debtor's shareholder's equity is regarded as a kind of the caller's asset market value, and the debtor's total liabilities (this article assumes no interest) D as the strike price of the execution price[1]. Based on the risk-neutral condition, the option price of a European call option is the value of its expected value discounted at a risk-free rate. Then the value of the debtor's stock at the moment $T = 0$ is the value of its expected value $\hat{E}[\max(V_T - D, 0)]$ discounted at the risk-free rate.

2) Derivation of Black-Scholes-Merton Debt Pricing Model

There are two methods for deriving the Black-Scholes-Merton debt pricing model: solving differential equations and deriving results based on risk-neutral pricing. This paper is based on the preconditions of risk neutral pricing.

Derivation prerequisites:

1. Based on risk neutral conditions;

2. Assume that the expected rate of return of the debtor's financial assets is consistent with the risk-free rate;

3. The company has no dividend distribution during the period;

4. The debt is a single interest-free liability and the borrowing period is assumed to be 1 year;

$$E = V_0 N(d_1) - De^{-rT} N(d_2)$$
$$d1 = \frac{\ln(\frac{V_0}{D}) + (r + \frac{\delta^2}{2}) * T}{\delta\sqrt{T}} \quad (11)$$
$$d2 = d_1 - \delta\sqrt{T}$$

Explanation of the symbol: E is the debtor's shareholder's equity;

V_0 is the asset market value of the debtor at the moment $T = 0$;

D is the debtor's point of default;

r is a risk-free rate;

δ^2 is the variance of the logarithm of the annual return on assets calculated by continuous compound interest;

T is the time from the expiration of the loan;

Under risk-neutral conditions, Black-Scholes-Merton debt pricing model treats the debtor's stock value as a call option with the total market liability as the execution price, with the total market value of the debt D as the target. Then, at the moment $T=0$, the stock value E is the present value after discounting its expectation at a risk-free rate r.

Therefore, at the moment $T=0$, its stock value is $E=e^{-rT}\hat{E}[\max(V_T-D,0)]$. Proof (11) is the expression of the stock value E of the company at the moment $T=0$. Namely: $E=e^{-rT}\hat{E}[\max(V_T-D,0)]$, V_T is the value of the asset market at the moment T.

The proof process is as follows:

Assume that the market value of the asset V is subject to the mean m and the lognormal distribution of variance w^2, ie $\ln V_T \sim N(m,w^2)$.

The properties of the lognormal distribution are: $m=\ln V_T-\frac{w^2}{2}$ .Standardization, let $Q=\frac{\ln V_T-m}{w}$, $Q\sim N(0,1)$, then the probability density function of Q is $h(Q)=\frac{1}{\sqrt{2\pi}}e^{\frac{-Q^2}{2}}$.

At the same time, we set $g(V_T)$ as the probability density function of the asset market value V_T at the moment T, and the upper and lower limits of the integral of V_A are replaced by the upper and lower limits of the integral of Q.

$$V_T\in(D,\infty),\ln V_T\in(\ln D,\infty),\ln V_T=Qw+m,D\in(\frac{\ln V_T-m}{w},\infty)$$

Prove

$$\begin{aligned}
E &= \hat{E}[\max(V_T-D,0)]\\
&=\int_D^{\infty}(V_T-D)g(V_T)d_V\\
&=\int_{\frac{\ln D-m}{w}}^{\infty}(e^{Qw+m}-D)h(Q)d_Q\\
&=\int_{\frac{\ln D-m}{w}}^{\infty}e^{Qw+m}h(Q)d_Q-\int_{\frac{\ln D-m}{w}}^{\infty}Dh(Q)d_Q\\
&=\int_{\frac{\ln D-m}{w}}^{\infty}e^{Qw+m}\frac{1}{\sqrt{2\pi}}e^{\frac{-Q^2}{2}}d_Q-D\int_{\frac{\ln D-m}{w}}^{\infty}\frac{1}{\sqrt{2\pi}}e^{\frac{-Q^2}{2}}d_Q\\
&=\int_{\frac{\ln D-m}{w}}^{\infty}\frac{1}{\sqrt{2\pi}}e^{\frac{2Qw+2m-Q^2}{2}}d_Q-D[1-N(\frac{\ln D-m}{w})]\\
&=\int_{\frac{\ln D-m}{w}}^{\infty}\frac{1}{\sqrt{2\pi}}e^{\frac{-(Q^2-2Qw+w^2)+w^2+2m}{2}}d_Q-DN(\frac{m-\ln D}{w})\\
&=e^{\frac{w^2+2m}{2}}\int_{\frac{\ln D-m}{w}}^{\infty}\frac{1}{\sqrt{2\pi}}e^{\frac{-(Q-w)^2}{2}}d_Q-DN(\frac{\ln V_T-\frac{w^2}{2}-\ln D}{w})\\
&=e^{m+\frac{w^2}{2}}N(Q-w)\Big|_{\frac{\ln D-m}{w}}^{\infty}-DN(\frac{\ln(V_T/D)-\frac{w^2}{2}}{w})\\
&=e^{m+\frac{w^2}{2}}[1-N(\frac{\ln D-m-w^2}{w})]-DN(\frac{\ln(V_T/D)-\frac{w^2}{2}}{w})\\
&=e^{m+\frac{w^2}{2}}N(\frac{w^2+m-\ln D}{w})-DN(\frac{\ln(V_T/D)-\frac{w^2}{2}}{w})\\
&=e^{m+\frac{w^2}{2}}N(\frac{\ln(V_T/D)+\frac{w^2}{2}}{w})-DN(\frac{\ln(V_T/D)-\frac{w^2}{2}}{w})
\end{aligned}$$

Also, by the nature of the lognormal distribution,

$$\ln V_T\sim N(\ln V_0+(\mu-\frac{\delta^2}{2})T,\delta^2 T)$$

Which is $m = \ln V_0 + (\mu - \frac{\delta^2}{2})T; w = \delta^2 T$

got

$$E = e^{-rT} \hat{E}[\max(V_T - D, 0)]$$
$$= e^{-rT}[e^{m+\frac{w^2}{2}} N(\frac{\ln(V_T / D) + \frac{w^2}{2}}{w}) - DN(\frac{\ln(V_T / D) - \frac{w^2}{2}}{w})$$
$$= e^{-rT}[e^{\ln V_0 + (\mu - \frac{\delta^2}{2})T + \frac{\delta^2 T}{2}} N(d_1) - DN(d_2)]$$
$$= e^{\ln V_0} N(d_1) - e^{-rT} DN(d_2)$$
$$= V_0 N(d_1) - De^{-rT} N(d_2)$$

This is the Black-Scholes-Merton debt pricing model and the results are as follows:

$$E = V_0 N(d_1) - De^{-rT} N(d_2)$$

Which $d_1 = \frac{\ln(\frac{V_0}{D}) + (r + \frac{\delta \wedge 2}{2}) * T}{\delta \sqrt{T}}$， $d_2 = d_1 - \delta \sqrt{T}$

3）The derivation of the relationship between δ_E and δ_V

The ratio of the volatility of stock value δ_E to the volatility of the market value of corporate assets δ_V is the elasticity of changes in the value of the company's equity to changes in the value of the company's assets[12].

$$\frac{\delta_E}{\delta_V} = \frac{\partial_E / E}{\partial_V / V} = (\frac{V_0}{E}) \frac{\partial_E}{\partial V}$$

by $E = V_0 N(d_1) - De^{-rT} N(d_2)$

got $\frac{\partial_E}{\partial_V} = N(d_1)$

and $\frac{\partial_E}{\partial_V} = (\frac{V_0}{E}) N(d_1)$

so $\delta_E = \frac{V_0 \delta_V}{E} N(d_1)$

4. An application to calculate the distance to default

This paper selects the data of 523 listed companies in the manufacturing industry in 2014.3.31 as a case to calculate the default distance. In this paper, the original input indicators for calculating the default distance of 523 listed companies are given as shown in Table1-2 (take 2014.3.31 as an example), the input index items in Tables1-2 and the input parameters for calculating the default distance is consistent with 2.1-2.2, the results of the distance to default of 523 listed companies is shown in Table 3:

Table 1 Input indicator data for calculating DD

Code	SD	LD	Circulating A shares	Limited sale of A shares	Weekly average closing price	BPS	DP	E
000049.SZ	1.56E+09	95488568	1.37E+08	0	35.85	4.28	1.6E+09	4.91E+09
000050.SZ	2.5E+09	1.77E+09	5.74E+08	22500	12.21	2.63	3.38E+09	7.01E+09
000059.SZ	1.59E+10	7.85E+09	1.2E+09	6144	4.49	5.71	1.98E+10	5.4E+09
000060.SZ	5.29E+09	2.63E+09	2.06E+09	1929542	5.61	2.96	6.6E+09	1.16E+10
000100.SZ	3.69E+10	2.16E+10	8.14E+09	3.97E+08	2.37	1.67	4.77E+10	2E+10
000400.SZ	4.21E+09	6.96E+08	3.96E+08	2.76E+08	21.97	7.04	4.56E+09	1.07E+10
000401.SZ	1.51E+10	1.44E+10	1.21E+09	1.35E+08	8.22	8.51	2.23E+10	1.11E+10
000404.SZ	4.08E+09	44007617	4.96E+08	64115069	5.22	3.53	4.1E+09	2.82E+09
000423.SZ	7.31E+08	93544524	6.54E+08	236558	33.66	8.30	7.78E+08	2.2E+10
000425.SZ	2.02E+10	9.78E+09	2.06E+09	7140665	2.20	9.57	2.5E+10	4.61E+09
…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…
300328.SZ	1.16E+08	37352116	28000000	84000000	5.37	5.24	1.35E+08	5.92E+08
300329.SZ	1.23E+08	450000	68588538	65391462	5.67	3.93	1.23E+08	6.47E+08
300331.SZ	1.15E+08	9227743	34857572	27142428	12.29	7.59	1.19E+08	6.35E+08
300334.SZ	2.43E+08	13099778	69573751	1.04E+08	22.38	4.54	2.5E+08	2.03E+09
300337.SZ	4.78E+08	83341650	74588000	1.12E+08	5.82	9.16	5.19E+08	1.46E+09
300342.SZ	87115827	9552735	33250000	66750000	6.96	7.69	91892194	7.45E+08
300345.SZ	1.77E+08	416396.5	61807053	34192947	3.38	6.48	1.77E+08	4.31E+08
300349.SZ	2.19E+08	2271363	22500000	67500000	27.01	8.56	2.2E+08	1.19E+09
300351.SZ	94691597	5151563	28340000	73840000	8.34	9.00	97267379	9.02E+08
300353.SZ	37059645	2040000	44127677	41492803	5.71	4.72	38079645	4.48E+08

Table 2 Raw data of the closing price of the GARCH (1,1) model

Code	20121010	20121011	20121012	20121015		20161230	20170103	20170104	20170105
000049.SZ	23.09343	22.98906	22.44108	22.44108	…	41.85994	40.20744	40.91423	40.56581
000050.SZ	7.942811	7.600449	7.414595	8.069974	…	18.76961	18.76961	18.76961	18.76961
000059.SZ	5.911613	6.195448	6.215023	6.195448	…	11.64705	11.6079	11.54918	11.8428
000060.SZ	8.096738	7.998596	7.900454	7.772869	…	11.08338	11.22254	11.35177	11.43129
000100.SZ	1.772471	1.754292	1.754292	1.763382	…	3.224786	3.351823	3.342051	3.342051
000400.SZ	8.584531	8.584531	8.584531	8.584531	…	18.05	18.45774	18.71631	18.70636
000401.SZ	12.03767	11.78486	11.54177	11.35702	…	11.9	12.24	12.54	12.54
000404.SZ	5.354697	5.194589	5.71049	5.674911	…	9.073303	9.182182	9.363648	9.318282
000423.SZ	36.88569	36.72861	36.57153	37.30148	…	53.13929	53.71142	54.15531	53.74101
000425.SZ	3.512768	3.448372	3.47735	3.438713	…	3.370203	3.380174	3.380174	3.410087
…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…
300328.SZ	4.437681	4.197806	4.170548	3.911592	…	11.70656	11.87622	12.0858	12.01594
300329.SZ	4.326315	4.282889	4.288317	4.288317	…	16.07008	16.58911	16.54918	16.43939
300331.SZ	11.34002	10.828	10.25689	9.58404	…	32.76426	32.72435	33.2232	33.64223
300334.SZ	11.6053	11.05792	10.95197	11.21683	…	18.16662	18.67625	18.7462	18.56633
300337.SZ	4.966862	4.67602	4.45507	4.452815	…	9.86	10.24	10.25	10.12
300342.SZ	3.337253	3.231614	3.24842	3.219609	…	17.52328	17.3252	17.35567	17.24139

300345.SZ	4.398546	4.182681	4.219819	4.029486	…	10.93506	11.19423	11.41353	11.36369
300349.SZ	11.58814	11.19309	11.29185	11.64082	…	31.7238	32.1125	32.58093	32.57096
300351.SZ	5.334664	5.363778	5.2518	5.166696	…	25.58661	25.38726	25.87567	25.73612
300353.SZ	3.516345	3.444017	3.631761	3.604061	…	15.13391	15.26343	15.61214	15.67191

Table 3 the results of the distance to default

Code	DD
000049.SZ	4.77483
000050.SZ	4.52011
000059.SZ	5.614077
000060.SZ	5.54667
000100.SZ	5.706431
000400.SZ	4.545479
000401.SZ	3.303306
000404.SZ	4.974173
000423.SZ	6.331667
000425.SZ	7.378292
…	…
…	…
…	…
300328.SZ	4.246681
300329.SZ	3.930643
300331.SZ	5.321666
300334.SZ	4.999794
300337.SZ	3.678442
300342.SZ	3.560729
300345.SZ	5.422215
300349.SZ	3.705972
300351.SZ	4.059858
300353.SZ	4.74048

5. Conclusion

The distance to default has good stability[5] in quantifying corporate credit risk, and the bigger the default distance, the lower the credit risk of the enterprise. On the contrary, the smaller the default distance, the higher the credit risk of the enterprise. Through the mathematical derivation of the KMV model related equations, the understanding of the KMV model is realized, which is very helpful for calculating the default distance.

If in the actual management of the enterprise, the role of the distance to default in quantifying the credit risk of the enterprise can be well considered, and the goal of improving the management efficiency of the enterprise can be achieved.

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