

# Research on Bank Financial Risk Control Mechanism Based on KMV Model

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**Abstract:** Starting from the loan users, KMV model transfers the evaluation of credit risk from the perspective of banks to the perspective of repayment enterprises, and judges whether the lending enterprises have repayment ability as the basis for evaluating credit risk. Credit risk is the core risk faced by commercial banks. When the economic situation fluctuates, people's economic expectations will gradually change, and the behavior of borrowers will also change. This paper studies the financial risk control mechanism of banks based on KMV model. This paper studies the credit risk status of 11 listed banks in China from 2018 to 2021, in order to observe whether macroeconomic changes have affected them since the new normal of economy. The empirical results show that the volatility of large commercial banks in each year is obviously lower than that of small and medium-sized commercial banks. The fluctuation range of weighted average default distance of large commercial banks is obviously smaller than that of small and medium-sized commercial banks. The empirical results show that KMV model has strong credit risk identification ability. The smaller the average default distance of an enterprise, the greater the corresponding default risk.

**Keywords:** KMV model, Financial risks, Credit risk.

## 1. Introduction

As the most important part of the financial industry, commercial banks' credit risk is an important cause of financial crisis and economic growth. Credit risk is the core risk faced by commercial banks. When the economic situation fluctuates, people's economic expectations will gradually change, and the behavior of borrowers will also change to some extent [1-2]. Under the background of active financial market, credit risk has become an important field of risk prevention and control, and it is also a challenge that commercial banks and other financial institutions must face. Therefore, the research on credit risk measurement of commercial banks not only has theoretical significance, but also has strong practical significance.

## 2. Research Method

### 2.1. Overview of KMV model

KMV model can be used to estimate the default probability of borrowing enterprises, which is established by KMV Company of the United States on the basis of option pricing theory. Starting from the loan users, KMV model transfers the evaluation of credit risk from the perspective of banks to the perspective of repayment enterprises, and judges whether the lending enterprises have repayment ability as the basis for evaluating credit risk. If the market value of the company's assets is lower than the total loan amount, the company's equity value is zero. In order to repay the loan, the company needs to realize all its assets, so the probability of default risk is high [3]. The company model is used to study a large number of sample data, and it is found that the model is most effective when the default point is set at current liabilities plus 0.5 long-term liabilities [4-5].

As the option pricing technology is now relatively mature, and the underlying assets of the "option" and their volatility can be directly observed, the introduction of the option concept in debt management can greatly simplify the debt risk

measurement, and the mature option pricing technology can be applied to debt management, thus improving the accuracy and effectiveness of debt management [6]. In this model, the definition of default is that the debtor can't pay the principal and interest due normally, and it is specified that the default will occur when the market value of the enterprise is equal to the debt level of the enterprise.

DPT (Default Point) is set as the enterprise's asset value level equal to the enterprise's debt level, and the EDF(expected default probability) is the probability that the current market value or asset value level of the enterprise will be reduced to the default trigger point level according to the fluctuation of enterprise's asset value.

$$DPT = STD + \frac{1}{2LTD} \quad (1)$$

$STD$  is a short-term debt and  $LTD$  is a long-term debt.

$$DD = \frac{E(V_d^T) - DPT}{\sigma_a} \quad (2)$$

$DD$  is the default distance,  $E(V_d^T)$  is the expected value of the company's assets in the future, and  $\sigma_a$  is the standard deviation of the fluctuation of the company's assets. It is not calculated by the B-S-M option pricing formula, but the standard deviation of the continuous compound return of the company's assets.

### 2.2. Bank financial risk control mechanism based on KMV model

Risk indicates the possibility of loss, and it is independent of human will. Under the situation that risk and return are

correlated in the same direction, and the higher the return, the higher the impact of risk on the market subject may be. Credit risk refers to the breach of credit caused by the influence of market main body's own factors, thus causing losses to business. The main risk faced by commercial banks in the course of operation is credit risk, which not only has the general characteristics of financial risks, but also has the characteristics different from other forms of financial risks.

In financial transactions, the business contacts between financial institutions are very close, and the outbreak of credit risk of a credit subject will spread to the whole financial industry in a short time, even most industries in the country. Therefore, if a commercial bank has credit risk, other commercial banks will be affected, even the whole credit chain, resulting in the paralysis of the national credit order [7-8].

Risk identification is the key step of risk management. Therefore, in order to effectively manage credit risk, we must first identify credit risk effectively. In the process of forecasting the cash flow of an enterprise or individual, it is necessary to fully consider its fixed assets, mortgaged and realizable assets and the profitability of customers. Besides, it is necessary to avoid covering up the real cash flow of customers because of the false financial situation. In addition, in the process of risk identification, banks should constantly improve their ability to identify risks according to the actual situation. At the same time, the dynamic rating of credit risk is carried out, and the use of credit funds is continuously tracked and recorded, supplemented by the credit measurement model to forecast the credit risk, so as to disperse, reduce and transfer its own credit risk.

Compared with the traditional measurement methods, the modern credit risk measurement model has made great progress in quantitative analysis, accuracy of results, prediction effect and scope of application. Modern credit risk measurement models all belong to quantitative analysis methods, which are based on strict financial theory and have obvious characteristics of quantitative analysis by using advanced credit risk quantitative technology [9]. Both the calculation process and the calculation results are supported by strong quantitative data. Modern credit risk measurement model belongs to quantitative analysis method, which needs more data as support. It is relatively complicated to measure credit risk by the results of quantitative data calculation, and it is relatively difficult to obtain data. Modern credit risk measurement model, especially KMV model, measures credit risk based on stock market data, which overcomes the

dependence on historical data and can better reflect the current credit status of enterprises. The results are forward-looking and have strong forecasting ability [10].

This paper thinks that KMV model is the most suitable model for our country at present. Based on the B-S-M option pricing theory, KMV model estimates the asset value and the volatility of asset value of an enterprise by using the equity value, the volatility of equity value and the default point of the enterprise, and calculates the default distance, thus obtaining the expected default rate of the enterprise. This paper will study the credit risk status of 11 listed banks in China from 2018 to 2021, in order to observe whether macroeconomic changes have affected them since the new normal of economy.

Assuming that the stock price of listed banks obeys lognormal distribution, the daily volatility of the stock is used to calculate its annual volatility. The daily logarithmic rate of return of the stock can be expressed as:

$$\mu_i = \ln\left(\frac{p_i}{p_{i-1}}\right) \quad (3)$$

$p_i$  stands for the closing price of the stock on day  $i$ , and  $p_{i-1}$  stands for the closing price of the stock on day  $i-1$ .

At this time, the standard deviation of the daily rate of return of the company's stock is  $\sigma^*$ :

$$\sigma^* = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (\mu_i - \bar{\mu})^2} \quad (4)$$

Where  $\bar{\mu} = \frac{1}{n} \sum_{i=1}^n \mu_i$ ,  $\mu$  is the average daily rate of return.

Then the annual standard deviation of stock returns can be obtained:

$$\sigma_E = \sigma_0 \times \sqrt{n} \quad (5)$$

**Table 1.** Value volatility of equity

Serial number	Bank	2018	2019	2020	2021
1	Bank of China	2018	2019	2020	2021
2	Agricultural Bank of China	0.205	0.2896	0.3594	0.1923
3	Industrial and Commercial Bank of China	0.1092	0.1786	0.3081	0.2529
4	Construction Bank	0.1286	0.2508	0.3415	0.1524
5	Bank of communication	0.1733	0.169	0.2816	0.1884
6	Industrial Bank	0.2398	0.1754	0.2692	0.2036
7	China Everbright Bank	0.195	0.2435	0.3636	0.2604
8	China CITIC Bank	0.2162	0.2045	0.3026	0.2701
9	Huaxia Bank	0.1432	0.2879	0.4192	0.3646
10	China Minsheng Bank	0.1978	0.2648	0.3573	0.3168
11	China Merchants Bank	0.3263	0.2164	0.3549	0.2463

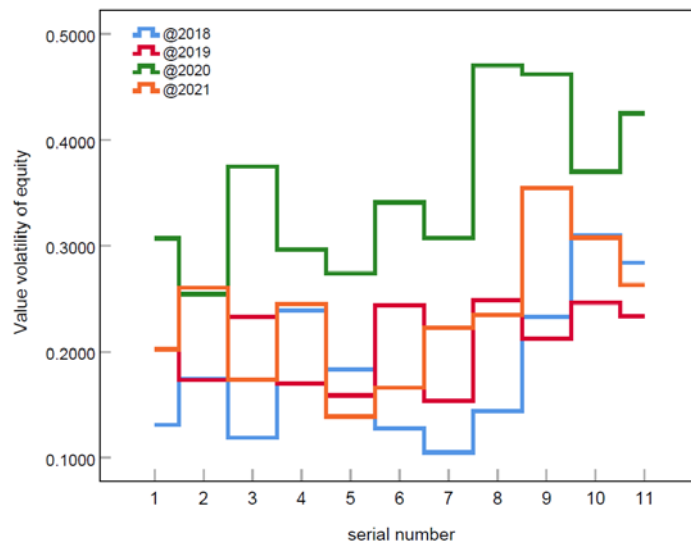


Figure 1. Equity value volatility curve

### 3. Result analysis

We estimate the parameters of KMV model by using the daily logarithmic returns of 11 listed banks from 2018 to 2021, and then use the model to get the volatility of daily returns, and then get the standard deviation of annual returns, that is, the volatility of equity value.

By using fGarch package in R language for model fitting, we get the daily return volatility of 11 listed banks from 2018 to 2021, and then get the standard deviation of annual return.

The results are shown in Table 1 and Figure 1.

Generally speaking, the volatility of 11 banks showed an upward trend from 2018 to 2021, peaked in 2020, and showed a stable or declining trend in 2021; Vertically, the volatility of large commercial banks in each year is obviously lower than that of small and medium-sized commercial banks.

Through a lot of research by scholars, it is found that when the company's value is about equal to current liabilities plus 50% long-term liabilities, default occurs most frequently, so the default distance of 11 listed companies can be obtained by calculation, and the calculation results are shown in Figure 2.

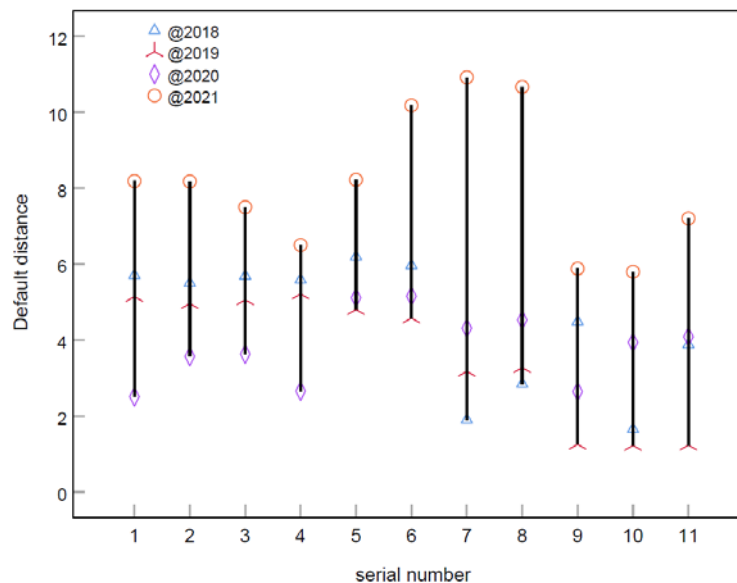


Figure 2. Default distance of listed banks

From 2018 to 2021, the weighted average default distance of both large commercial banks and small and medium-sized commercial banks showed a downward trend, and it rose after 2018, indicating that the credit risk of China's commercial banks first increased and then decreased. The reason for this feature may be related to the new normal of China's economy and the adjustment of industrial structure. From 1.54% in 2018 to 1.96% in 2021, the credit risk of banks is increasing.

KMV model can not only identify the credit risks of different types of enterprises, but also the differences of credit risks of enterprises in different industries and regions, which

further proves that this model is not only suitable for micro-enterprise analysis, but also for meso-level analysis. This requires commercial banks to be cautious when using KMV model to measure credit risk, and strive to assist other information to comprehensively measure the company, so as to make the credit risk measurement result more accurate, more reliable and more valuable.

### 4. Conclusions

Under the background of active financial market, credit

risk has become an important field of risk prevention and control, and it is also a challenge that commercial banks and other financial institutions must face. Therefore, the research on credit risk measurement of commercial banks not only has theoretical significance, but also has strong practical significance. This paper studies the financial risk control mechanism of banks based on KMV model. This paper will study the credit risk status of 11 listed banks in China from 2018 to 2021, in order to observe whether macroeconomic changes have affected them since the new normal of economy. The results show that the volatility of large commercial banks in each year is obviously lower than that of small and medium-sized commercial banks. The fluctuation range of weighted average default distance of large commercial banks is obviously smaller than that of small and medium-sized commercial banks, which shows that large commercial banks are more resistant to the interference caused by changes in external conditions, while small and medium-sized banks are more susceptible to external shocks.

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