Risk of credit assessment of Chinese bank of commerce based on KMW model and its empirical research

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Abstract. Taking Chinese commercial banks credit risk into account, we analyse a situation of many listed commercial banks. Based on the sample Banks' financial data in recent years, an analysis of measurement model of risk of credit, using the KMV model to measure bank’s risk of credit, and monitor the model of our country commercial bank risk of credit measurement in practical, to find a suitable way for the reality of our country's risk of credit model to enhance the competitiveness of Chinese commercial banks.

1. Credit risk of commercial banks

Risk of credit which is also known as performance or counterparty risk means risk that the transaction party not fulfilling its obligations due. Chinese commercial banks have adopted the traditional method of subjective evaluation in measurement of risk of credit for a long time. Credit supervisors make credit decisions after analyzing the financial statements and recent settlement records of borrowing enterprises. This way of management has many disadvantages. At the present stage, due to immature Chinese market development and lack of conditions to reflect the market value of enterprises through their stock prices, we can try to establish a small-scale model for special customer groups. But, the loan portfolio risk measurement analysis, marginal analysis thought is worth using for reference. Since the accumulation of historical data in China is just beginning, the measurement of credit risk should be strengthened to evaluate the current status of enterprises and predict the future. Meanwhile, the measurement of non-financial factors on credit risk impact would be strengthened in view of the lagging financial data and low credibility of domestic enterprises.

2. KMV model

KMV model is a way to evaluate borrowers’ probability of default. This model is in the case of a given debt that the risk of credit of loan is determined by the participants’ assets present market value(MV). But in real market transactions there is no real assets and we cannot directly observe the MV of the assets. Thus, the model will bank loan back problems a point of view, from the Angle of the borrowing enterprise owners consider question to repay the loan.

The model holds a company would make default upon its shareholders and creditors when asset carrying value(CV) of a company falls lower than a fixed level. Corresponding to the level of value of the asset(CV) as a default point namely company's assets at which this value is adequate for the debt value. Distance between average future value of assets and carrying value of liabilities to be paid off is the default distance. Correspondence distance to calculate the rates in normal market conditions, namely the borrowing company, thought to have fallen when the asset value of the mean to the model needed to
pay off the book value of the company liabilities under default occurs, because unable to accurately judge the company will choose a default in advance, so can only estimate the likelihood of default size.

3. Empirical analysis

3.1. Selection of Samples

Because not all commercial banks are institutions with long listing time, complete data, credit rating and empirical data, and because our commercial banks do not publish the list of defaulting enterprises, it is difficult for outsiders to identify defaulting enterprises, so this paper chooses companies with high probability of defaulting as a control. This paper defines default company and non-default company, taking Shanghai and Shenzhen stock market companies as samples. There are high-performance stocks, medium-performance stocks, ST stocks and *ST stocks in China’s securities market. Among them, ST shares refer to the stocks issued by companies with abnormal conditions and operating losses. Moreover, in the past, most ST companies in our country got rid of the definition of ST through large-scale asset restructuring. This shows that ST companies have encountered great financial and economic difficulties, which is in line with the description of the characteristics of the company in the event of financial crisis.

3.2. Parameter setting

In the parameter setting process, we have the following assumptions:

a) The data cited in the accounting statements of listed banks are true, fair, accurate and credible.

b) To be simple, we put the debt of the maturity at $T = 1$; take risk-free rate of interest, $r = 3.00\%$.

c) Total value of bank stocks is the product of total equity and the base day’s closing price, i.e. equity value = total equity * the base day closing price.

d) Because it is difficult to count the current liabilities of banks, we take the total liabilities as the default point and the total liabilities published in the financial statements.

e) Formula for calculating default distance $E(V_0) = V_0$, then $DD = \frac{V_0 - DPT}{V_0 \sigma_0}$

3.3. Empirical calculation process

3.3.1. Calculating stock price volatility. Assuming the closing price on the $n^{th}$ day is $S_n$. If the stock price satisfies lognormal, logarithmic return of the stock price is:

$$R_n = \ln\left(\frac{S_{n+1}}{S_n}\right)$$

Price earning ratio $R_n$. Standard deviation estimates can be computed:

$$\sigma_m = \sqrt{\frac{1}{m-1} \sum_{n=1}^{m} (R_n - E(R))^2}$$

Among

$$E(R) = \frac{1}{m} \sum_{n=1}^{m} R_n$$

Daily earnings volatility can be obtained by substituting stock price data. as follows:

$$\sigma_x = \sigma_n \times \sqrt{N}$$  (N is trading days number in a year, $N = 242$)

Results are shown as follow.

| Securities code | Securities abbreviation | Daily return volatility($\sigma_n$) | Annual earnings volatility($\sigma_x$) |
|-----------------|-------------------------|-------------------------------------|-------------------------------------|
| 000001          | Ping An Bank            | 0.014593                            | 0.227016                            |
| 600000          | Pudong Development Bank | 0.013673                            | 0.212704                            |
| 600036          | China Merchants Bank(CMB) | 0.014044                        | 0.218470                            |
| 601288          | Agricultural Bank of China(ABC) | 0.008832                    | 0.137394                            |
| 601328          | BoCom                   | 0.011232                            | 0.174713                            |
| 601398          | ICBC                    | 0.009194                            | 0.143013                            |
| 601818          | China Everbright Bank   | 0.011138                            | 0.173276                            |
| 601939          | CCB                     | 0.010135                            | 0.157643                            |
| 601988          | Bank of China           | 0.008084                            | 0.125204                            |
| 601998          | CITIC Bank              | 0.012847                            | 0.100859                            |
### 3.3.2. Calculating distance of default (DD) and rate of expected default (EDR)

There are following equations:

\[
\begin{align*}
V_E &= V_0 N(d_1) - D e^{-rT} N(d_2) \\
\sigma_E &= \frac{N(d_1)\sigma_0}{V_E}
\end{align*}
\]

The value of asset and volatility is able to be calculated, and sample banks’ distance of default is able to be calculated using the following formula:

\[
DD = \frac{V_0 - DPT}{V_0\sigma_0}
\]

Then rate of default of samples is calculated using the following formula:

\[
EDF = \left[1 - N(DD)\right] \times 100\%
\]

And calculation results are as follow.

**Table 2. Distance of Default & Rate of Expected default**

| Securities code | Securities abbreviation | Distance of Default (DD) | Rate of Expected default (EDF) |
|-----------------|-------------------------|--------------------------|--------------------------------|
| 000001          | Ping An Bank            | 0.199108                 | 0.421089                       |
| 600000          | Pudong Development Bank | 0.698365                 | 0.242473                       |
| 600036          | China Merchants Bank    | 0.543092                 | 0.293534                       |
| 601288          | Agricultural Bank of China(ABC) | 1.453451 | 0.073094                       |
| 601328          | BoCom                   | 1.083245                 | 0.139351                       |
| 601398          | ICBC                    | 1.304295                 | 0.096066                       |
| 601818          | China Everbright Bank   | 0.447575                 | 0.327231                       |
| 601939          | CCB                     | 1.454674                 | 0.072881                       |
| 601988          | Bank of China           | 1.592676                 | 0.055615                       |
| 601998          | CITIC Bank              | 1.059036                 | 0.144792                       |

### 3.3.3. Empirical results

On the basis of calculating the default distance, we estimate probability of expected default. If probability of expected default is higher, risk of default is higher and the credit rating is lower. By comparing calculated DD and EDR with Standard & Poor's Depository Receipt (SPDR) and Moody's rating of sample banks, we can see that a corresponding relationship between expected default rate and credit rating existing. Testing EDF value of each bank basically coincides with its credit rating, which reflects that the default rate of listed banks can be correctly shows by KMV model in general.

### 4. Conclusions and suggestions

On the one hand, from the empirical process and method, we can see that the size of assets, solvency, profitability, asset and stock price stability of banks are the main financial factors affecting credit risk by measuring credit risk by EDF. If the scale of assets are larger, the profitability and solvency is stronger, the volatility of assets are smaller, the distance of default of banks is bigger, the rate of expected default is smaller and the risk of credit is smaller, and vice versa.

Using KMV model, the EDF of each bank is calculated to be consistent with its credit rating, which indicates that EDF can be used as a credit risk measurement index reflecting the credit status of listed banks to a certain extent. Because it is easy to obtain KMV model data, easy to calculate and easy to practical, at this stage it is suitable in China to manage credit risk management.

On the one hand, in the view of practical significance, as the stock market gradually perfect and mature, the enterprise data and information disclosure system will be more perfect, the KMV model will have a broader application prospect.

On the other hand, to improve Chinese commercial banks’ credit management level, we suggest that banks should improve customer credit management, a differential pricing and portfolio strategy should be implemented. Banks should also form professional and high-quality risk management team. For
default, banks should establish a unified, large-scale database and share credit data to better control and avoid risk of credit.

References
[1] Tang Chunyang, Zhang Heng, Ma ruowei: application of KMV model in credit risk of commercial banks, accounting research, 2006, No. 10.
[2] Douglas W.Dwyer, Irina Korablev. Power and Level Validation of Moody’s KMV EDF Credit Measures in North America, Europe and Asia. Moody’s KMV Corporation.2007 (9). http://moodykmv.com.
[3] Zhang Yiqiang, Yang Xing: Empirical Study on credit risk management of Listed Companies in China -- the role of KMV in credit evaluation, economic forum, 2007, issue 7.
[4] Wu Hengyu. Review on KMV model of corporate credit risk [J]. Journal of Guangdong University of administration, 2005, [2].
[5] Ma Jian, Zhang weibeng, Liu Xinmei. Comparative analysis of modern credit risk models [J]. Business research, 2004, [8].
[6] Kang Yuhong, sun depeng, Gao Zhonghua: Empirical Research on KMV model in credit risk measurement of Listed Companies in China, see proceedings of the third (2008) China management academic year conference, 2008.