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SELECTED METHODS OF CREDIT RISK EVALUATION

Abstract. Over the last few years credit risk and its minimalization have been widely discussed. Therefore the problem of credit risk and methods of its evaluation seem to be quite important. In the article there were presented various models of credit risk using statistic information and they ware shortly characterized. It should be emphasized that the discussed methods in many cases situations can make it easier to take difficult credit decisions.

Key words: credit, credit risk, risk methods, default mode, mark to market.

1. INTRODUCTION

Nowadays there is a tendency to search for new methods that, with the use of a well-developed statistic base, allow to evaluate the credit risk. Information that we receive due to the method of credit risk evaluation, help to take a decision to grant or refuse credit to a potential debtor. The recently introduced methods of credit risk differ in concept, specification, basic parameters and the way of results evaluation.

Taking into consideration the concept approach there can be selected the following risk methods:

- DEFAULT MODE (DM) – estimating the value of the unexpected losses (the, so called, unexpected losses approach), this model includes Credit Risk Method + Credit Portfolio View;
- MARK TO MARKET model – including:
  - EDF model (neutral estimation of the risk), the approach prepared by KMV Corporation,
  - RNV (risk neutral valuation),
  - CREDIT METRICS model of discounted contractual cash flow.

The first drawing presents the division of credit risk models that make us of statistic information:

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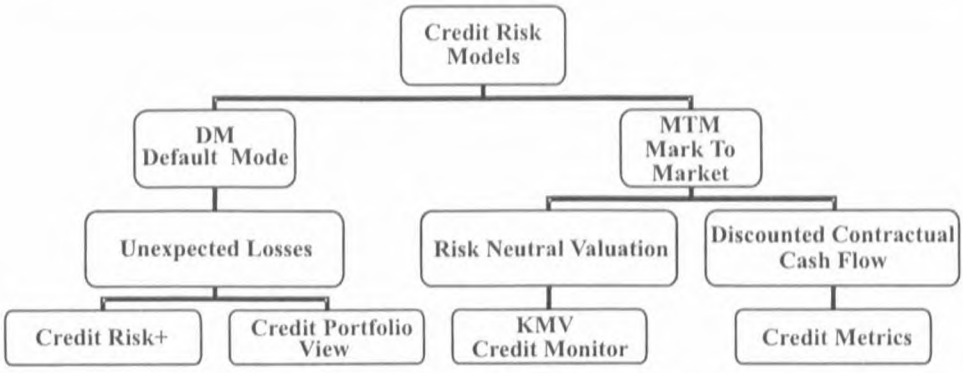

Fig. 1. Classification of credit risk models

It should be emphasized that there are many various methods of credit risk valuation and analysis. The complexity of the problem of credit risk makes it difficult to prepare the simple classification of the methods of risk analysis (B o r y s 1995). The aim of this analysis is the presentation of the model of expected default frequency and its usability in taking credit decisions.

2. EXPECTED DEFAULT FREQUENCY

The example of the model connected with capital market (stock valuation) is the EDF model (expected default frequency), prepared by KMV Corporation. This approach is based on assets evaluation, the method prepared by R. Merton in 1974 with the use of option's theory. According to KMV method, it is assumed that the process of a company's insolvency is an endogenous process (depends on the company itself) and is determined by the company's capital structure. Failure to meet the credit liabilities is caused by the decline in the assets' value of the debtor below the level necessary for the loan attendance. Credit is considered to be the derivative instrument based on assets value of a debtor. The most characteristic feature of this approach is the fact that it links directly and strongly the market value of a company with with bankruptcy probability. The changes in insolvency probabilities are interdependent with shareholders' equity. According to KMV Corporation approach this connection is crucial, since it allows to link the information on the company valuation (stocks value) with the creditworthiness/credit rating. It is assumed that insolvency of a company is likely to appear when a company's assets value is lower than the specified critical value. This method aims at stating the expected default frequency (J a w o r s k i 2001). This method is always introduced in stages.

During the first stage market value of a company is defined together with the variability of this value, estimated on the basis of fluctuation of a company's stock prices and the bookkeeping value of a company's liabilities. During the second stage the default point is evaluated on the basis of the current liabilities value of a company. During the third stage a special measure, called the distance to insolvency, is decided. In the fourth stage, on the basis of the historical data, the expected default frequency – EDF-is estimated.

In the above mentioned approach it is assumed that a company becomes insolvent the moment its market value (goodwill) falls below the certain critical level. Figure 2 presents the momentary forecast of the future of a company's value on the basis of the value of its assets. The EDF space is the probability of a company's insolvency. It is influenced by the level of liabilities and assets value.

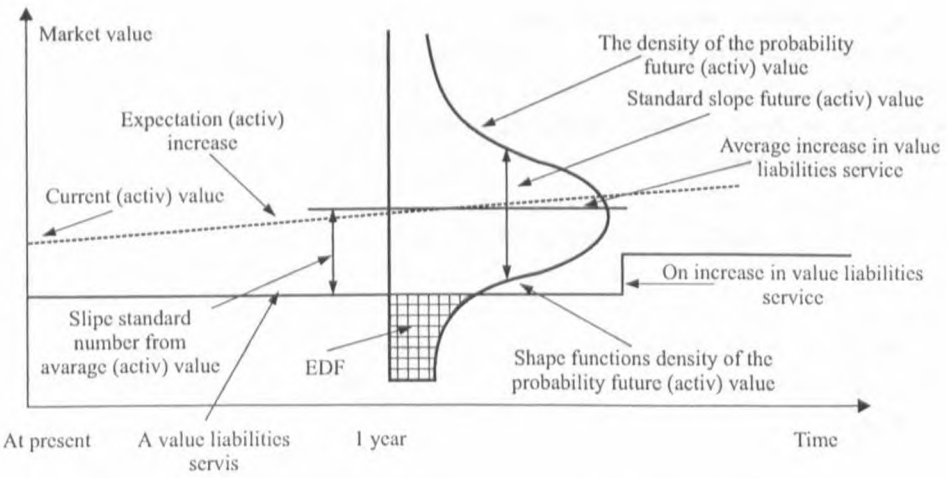

Fig. 2. The scheme of the valuation of insolvency probability in KMV methods

In case of the listed companies market value of their capital can be estimated on the basis of their stock prices. Additionally, using the options' theory, market value of capital can be equal to value of the purchase option (J a w o r s k i 2001).

$$\text{market value of capital} = f(\text{liabilities' bookkeeping value, market value of assets, variability of assets, time}) \quad (1)$$

Using BLACK-SCHOLES model and the formula for option valuation, we will get the following formula (H u l l 1997):

$$E = AN(d_1) - De^{-rt}N(d_2) \tag{2}$$

with the following:

E – market value of capital (value of options),

D – bookkeeping value of liabilities (price of option making),

A – market value of assets,

t – time,

r – return rate of risk-free investment of assets,

N – distribuant of normal division, whose d_1 and d_2 are as follows:

$$d_1 = \frac{\ln\left(\frac{A}{D}\right) + \left(r + \frac{1}{2}\sigma_a^2\right)t}{\sigma_a\sqrt{t}}, \quad d_2 = d_1 - \sigma_a\sqrt{t},$$

σ_a – standard variation of assets.

In the equation (1) and (2) there are two unknowns: market value of assets (A) and variability of assets' value. However, there is a possibility to work out another equation from the formulas (1) and (2) by differentiating both sides of equation:

variability of capital = h (liabilities' bookkeeping value, market value of assets, variability of assets, time) (3)

On the basis of BLACK-SCHOLES formula, the authors of the approach work out the formula for variability of capital value, achieving the following equation:

$$\sigma_e = \frac{N(d)A\sigma_a}{E} \tag{4}$$

σ_e – variability of capital evaluated on the basis of historical data,

σ_a – variability of the assets' value,

the remaining variables – as in the above mentioned formulas.

The two unknowns are the market value of assets (A) and the variability of assets value (σ_a). They are followed by: expected assets' value in the given time and insolvency point.

An investor having some type of assets expects that he will have return on the investment and additionally will get income equal to the expected rate of return from assets. The expected rate of return is considered in

terms of the systematic risk connected with analyzed assets. According to KMV the systematic risk of assets means the expected rate of return on assets on the basis of historical profitability of assets.

The future value of a company's assets (A_t) is calculated using the following formula:

$$A_t = A_0 e^{\left(\left(u - \frac{s_a^2}{2}\right)t + s_a\sqrt{tZ_t}\right)} \tag{5}$$

Using logarithms we achieve the following:

$$\ln A_t = \ln A_0 + \left(\left(u - \frac{\sigma_a^2}{2}\right)t + \sigma_a\sqrt{tZ_t}\right) \tag{6}$$

where:

A_0 – value of assets at the beginning,
A_t – value of assets at the particular moment t,
$Z_t \sim N\ (0,1)$,
u – average rate of return on a company's assets,
σ_a – standard variation of the rate of return on assets.

The value of assets A_t can be substituted by factoring logarithmically-normal of the value expected in a given moment t, presented with the following formula:

$$E(A_t) = A_0 e^{ut} \tag{7}$$

It should be emphasized that from the very beginning it was assumed that a company would become insolvent when the total market value of its assets should achieve a critical value. The bookkeeping value of its liabilities is considered to be this critical value. In such situation the value of a company's assets will only enable the company to pay all the dues. With the use of the empirical analysis of the bankruptcy of companies it has been observed that in many cases the loss of liquidity appears when the total assets are lower than the level of total liabilities. On the basis of historical data it seems that the most common point of a company's insolvency is the moment when the value of assets is equal to short-term liabilities enlarged with 50% of long-terms liabilities. These observations make it possible to mark the point of insolvency with the use of the following formula (J a w o r s k i 2001):

$$\text{insolvency point} = \text{short-term liabilities} + 0.5\ \text{long-term liabilities} \tag{8}$$

When having the expected value of a company's assets in given time and its insolvency point (default point), in the third stage this method defines the percentage loss of a company's value, that can lead to bankruptcy, i.e. to the default point. For instance, if the expected company's value during one year period is 100, and its default point is 25, it can be concluded that the downfall of 75% in the assets' value will lead a company to the default point. Next step is defining the, so called, distance to the point of insolvency. This can be made using the following formula:

$$\text{distance to the point of insolvency} = \frac{\text{expected assets' value} - \text{default point}}{\text{variability of assets}} \tag{9}$$

The possibility of the loss of liquidity shall be marked as P_{def}. The critical point of assets A_{def}, in which a company becomes insolvent can be presented with the following formula:

$$P_{\text{def}} = P(A_t \leqslant A_{\text{def}}) = P(\ln A_t \leqslant \ln A_{\text{def}}) \tag{10}$$

It means that for a given company with the rating $X \in \{AAA, AA, A, BBB, BB, B, CCC\}$ there can be defined such a value Z_{CCC}, for which the downfall of the value of a company's assets below this level will mean the insolvency of a debtor.

Knowing the value Z_{CCC} for the standard normal factoring of assets' value, the probability of the loss of liquidity can be defined:

$$P_{\text{def}} = P\left[\ln A_0 + \left(u - \frac{\sigma_a^2}{2}\right)t + \sigma_a\sqrt{t}Z_t \leqslant \ln A_{\text{def}}\right] \tag{11}$$

After the conversion we get:

$$P_{\text{def}} = P\left[\frac{\ln\left(\frac{A_{\text{def}}}{A_0}\right) - \left(u - \frac{\sigma_a^2}{2}\right)t}{\sigma_a\sqrt{t}} \geqslant Z_t\right] = P\left[Z_t \leqslant -\frac{\ln\left(\frac{A_0}{A_{\text{def}}}\right) + \left(u - \frac{\sigma_a^2}{2}\right)t}{\sigma_a\sqrt{t}}\right] \equiv N(E - d_2) \tag{12}$$

where the standardized rate of return $r \sim N[0, 1]$:

$$r = \frac{\ln\left(\frac{A_t}{A_0}\right) + \left(u - \frac{\sigma_a^2}{2}\right)t}{\sigma_a\sqrt{t}}.$$

Z_{CCC} is the point in the standard normal factoring corresponding to the possibility of loosing liquidity P_{def}. It means that the critical value of assets when there appears insolvency (A_{def}) is the one in which $Z_{CCC} = -d_2$:

$$d_2 = \frac{\ln\left(\frac{A_0}{A_{def}}\right) + \left(u - \frac{\sigma_a^2}{2}\right)t}{\sigma_a\sqrt{t}} \tag{13}$$

The above mentioned formula presents in a formal way measure of the distance to insolvency.

The aim of the measure distance to insolvency is the comparative analysis of companies. Distance to insolvency is a measure allowing the rating of companies. However, it does not give direct information on the probability of bankruptcy. In order to make a further use of this measure of risk of bankruptcy probability, KMV Corporation analyses the historical data on the companies that went bankrupt. The knowledge of the level of measure of distance to insolvency for the companies that in the past lost liquidity makes it possible to evaluate the probability of insolvency as the function of "distance to insolvency". It means that on the basis of experience and historical data, after calculating the distance to insolvency, we are able to estimate the probability of loosing liquidity – EDF. The historical data show that the probability of the bankruptcy (EDF), depending on the level of "distance to insolvency" tends to be as Fig. 3.

Taking into consideration the above mentioned graph the bigger value of the distance to insolvency, the smaller probability of a company's bankruptcy. It can be proved on the following example:

Let us assume that the value of a company's assets is $A = 2000$, the expected monthly inscrease of assets is 20%, it means that the expected value of assets in a year will be $A = 2400$, the yearly variability of assets $= 100$, and the point of insolvency – 2000. With these data the measure of distance to insolvency is as follows:

$$DD = \frac{2400 - 2000}{100} = 4.$$

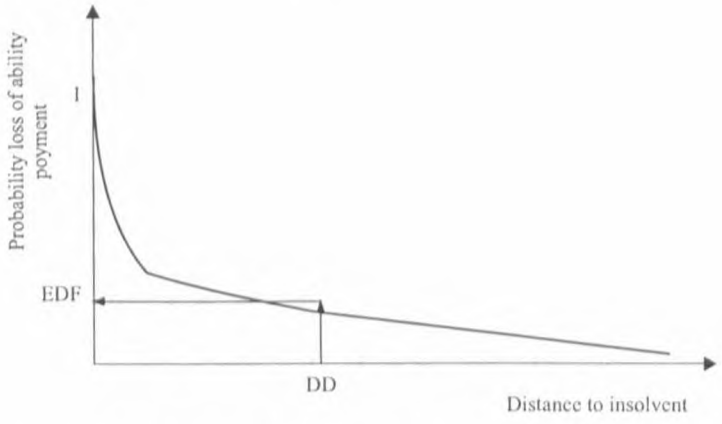

Fig. 3. The estimation of the values of probability of bankruptcy on the basis of historical data

Taking into consideration the historical data, on the basis of which one can claim that in the group of 8000 companies that achieved the value of the distance to insolvency of 4, only 60 went bankrupt one year later, it can be concluded that the probability of bankruptcy of a given company, counted with EDF measure, will be as follows:

$$EF = \frac{60}{8000} = 0.0075 = 0.75\%.$$

3. CONCLUSIONS

The EDF model is the new approach in banking, that uses the stock exchange data for the evaluation of a company. The forecasted value of this method results from the fact that the current value of a company determines its future value. Because of the fact that the future value of a company's assets is educed only from the market value of a company's capital, the model EDF depends completely on the information given by the market evaluation of the company's stocks. Additionally, it is worth mentioning that credit institutions present careful approach to new methods helping in making decisions. However, using of the above mentioned method together with the ones already checked would facilitate taking difficult decisions.

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WYBRANE METODY SZACOWANIA RYZYKA KREDYTOWEGO

W ostatnich latach wiele miejsca poświęca się ryzyku kredytowemu i jego minimalizacji, dlatego też słuszne wydaje się poruszenie tematu związanego z metodami szacowania ryzyka kredytowego.

W artykule starano się przedstawić podział modeli ryzyka kredytowego wykorzystujących informacje statystyczne oraz dokonano krótkiej ich charakterystyki. Należy zauważyć, iż omówione metody nie są metodami całkowicie eliminującymi ryzyko, ale w wielu przypadkach mogą ułatwić podjęcie trudnych decyzji kredytowych.