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Comparative analysis of theoretical aspects in credit risk models

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Abstract

The main aim of presented article is comparison of basic characteristics and mutual comparison of two basic credit risk models. Namely we will compare Merton and KMV models. There is significant increase of credit risk importance in global economy and also in business sector nowadays. We focus on differences in computational procedures, individual credit risk modelling techniques, as well as the variability in input parameters, used for risk quantification. The result will be comprehensive overview of these models differences as well as the presentation of basic recommendations for their usage along with the mention of their advantages and disadvantages. We will also mention test results of various renowned agencies, which reflect the accuracy of these models.

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1. Merton model

This model is based on the idea that shares and debt can be seen as derivatives of corporate assets. This view of corporate obligations brought Black and Scholes in his work from 1973. Merton developed their idea in his work which was published a year later. From this work on, all other structural models are based on this the basics set by Merton, but they move much closer to reality because they abandon some of its strict assumptions.

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1.1. The basic assumptions of the model

The fundamental equation which determines the value of the security is an integral part of the structural models. It is necessary to adopt following assumptions during the derivation of fundamental equation:

1. The absence of transaction costs, taxes, and problems with the divisibility of assets.
2. Each investor can buy and sell at the market price desired amount of assets.
3. Interest rates are equal.
4. The possibility to apply a short sale
5. Trading of assets takes place in continuous time.
6. Modigliani-Miller theorem is valid, ie. value of the firm is independent of its capital structure.
7. We consider the constant risk-free rate, ie. assume a flat yield curve.
8. The dynamics of the assets value can be described by a stochastic differential equation (SDE):

$$dV_t = (\alpha V_t - C)dt + \sigma V_t dW_v \tag{1}$$

where:

α – is the instantaneous expected rate of return on the company's value per unit of time,
C – is the sum of dividends paid on the value of the company per unit of time (positive or negative),
σ – is the standard deviation of random components of company's value,
dW_v – is Wiener's random process.
Stochastic process is described in SDE as a special form of Ito's process.

Defintion 1 –Ito's process
Process C (t) is called Ito's process if it can be expressed in the form:

$$X(t) = X(0) + \int_0^t \alpha\,(t)dt + \int_0^t \beta\,(t)dW(t), \tag{2}$$

where are adaptation processes that integrals exist. Formally, this term may be written in the form of stochastic differential as:

$$dX(t) = \alpha(t)dt + \beta(t)dW_t \tag{3}$$

Assumptions 1-4 are the assumptions of perfect competition. The assumption number 5, is sufficient for the stock markets to trade for most of the day.

An important assumption is the Modigliani-Miller theorem. MM theorem says that in the absence of taxes, bankruptcy costs, asymmetric information, and efficient market, the company value is not affected by the manner of its financing. The two companies, which are completely identical except for the fact that one of them is financed with equity capital and other one with foreign debt capital have the same value by MM theorems. It follows by the fact that the value of company performs in the model as an exogenous variable, which is confirmed by the assumption 8. The validity of this assumption was proved by Merton during the construction of model. The validity of this argument, however, stems from the other assumptions of Merton model, mainly due to the absence of taxes, which have to be taken into account according to Gavlakova, Kliestik (2014). In later models, it was retreated from this assumption and thus also automatically retreated from the MM theorems.

The last assumption 8 itself implicitly contains the validity of the efficient markets. As we wrote above, the theory of efficient markets has two subhypotheses - successive price changes are independent and governed by some probability distribution. The consequence of this assumption is therefore a condition of continuous course of changes in prices and also the condition of their mutual independence. In addition, the following definition of company value development meets the requirements which are usually put to the development of the company's value. According to Kliestik et al. (2014) dpecifically, we are referring to the requirement that the value of the company is always positive and model is versatile for different levels of the company's value. The development of V_t can be decomposed into two components and that are the trendy deterministic and random components. A random component is represented by Wiener. Non-random component then gains exponential functions which is corresponding to model of the assets prices movement derived above.