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## Comparison of Selected Models of Credit Risk

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### Abstract

Credit risk presents the probability of loss that the company incurs in the event of a business partner (the counterparty) default. The default may occur if the liabilities are not met under the terms of the contract which in turn results into the loss of the company (the creditor). Specifically, the liabilities arose from the credit, trade or investment activities, payment system and trade settlement. Difficulties in credit risk modelling arise due to the fact that the company default is not a frequent phenomenon but it occurs mainly unexpectedly. However, if the default occurs, it often causes the creditors major losses which size cannot be quantified in advance. The issue of modelling and quantification of credit risk is the subject of interest of many studies, scientific articles and publications. The access of individual authors to the present issue is diverse and so the methodology used for this purpose is not uniform. The present contribution will address the analysis and comparison of four basic approaches of description, but especially the quantification of credit risk: CreditRisk+, Credit Metrics, Merton model and Credit Grades. The comparison will be made on the basis of the computer performance, the applicability to different types of companies (public or non-public tradable), the volatility of credit events, the correlation of credit events occurrence, the required input data, currency of data and such like. Conclusions and recommendations for the application of the various approaches in specific situations will be parts of the contribution.

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## 1. Introduction

Credit risk represents loss probability that the firm incurs in the case of business partner failure (counterparty). For this failure, we can consider failure to fulfil the obligations under the terms of the contract, which in turn results in the business (creditor) loss. Specifically, we are talking about obligations arising from the credit, trade or investment activities, payment and settlement. As an example, we can choose defaults on loans to clients, customers outstanding invoices, overdue obligations arising from the issuance of debt or equity securities or obligations arising from trading in financial and capital markets, and the like. (Kollár, 2014)

Banks and financial institutions are particularly vulnerable against credit risk (Spuchľáková & Cúg, 2014). Credit risk is one of the fundamental banking risks and also risk area, which contains majority of the banks losses. Virtually all banks in the world are facing the problem of bad debts (outstanding loans). They must therefore constantly improve their models and practices in the area of credit risk management and find new, more effective ways to prevent it.

Most often, we define credit risk as the risk of losses due to defaults on loans to borrowers. It is the case, when the other party in a financial transaction will not behave in accordance with the terms and conditions of contract, causing financial loss to the holder of assets (Valášková, Gavlaková & Dengov, 2014). However, exposure to credit risk arises in the whole range of bank's activities, not only in providing loans, for example, during the process of issuing loan commitments and guarantees in bankers' acceptances, in trading on the capital market when dealing with foreign exchanges, futures, swaps, bonds, options, stocks, etc... (Bartošová, 2005).

Difficulties in credit risk modelling arise from the fact that business bankruptcies (defaults) are not frequent phenomenon but occur mainly unexpectedly. However, if default occurs, in fact, it often causes major losses to lenders or creditors, but we do not know how to quantify their size in advance. Approach of individual authors to this issue is diverse and so is the methodology that is used for this purpose. (Mišanková, Kočíšová, 2014b)

The first and historically the oldest group are structural models. They consider business failures to be endogenous event, which is also affected by capital structure. Therefore, they are called structural models in literature. They are based on the assumption that credit events are determined by the changes in value of company. Therefore, they are mainly focused on modelling of company value development and are based on economic fundamentals of firm theory. Most models assume that default occurs at a time, when the company value falls below given threshold for the first time. In other words, at this time the business no longer has assets of sufficient value, to be able to cover all its obligations. Among the authors who deal with the structural credit risk models, we include for example (Black & Scholes 1973; Merton 1974; Black & Cox 1976; Kealhofer, McQuown & Vasicek 2003a, 2003b; Geske 1977), (Longstaff Schwartz, 1995; Dufresne, Goldstein, & Martin, 2001) and others.

Reduced models are not based on strong economic structure like structural models. While structural models are dependent on capital structure, reduced models perceive the default as an exogenous variable and try to explore its course. Unlike structural models, which seek the help of structural variables to explain credit spreads, reduced models use credit spreads as an input for failure probability calculation. We recognise two types of models: models based on the intensity and credit migration models. The first group put emphasis on modelling the random time of default as a time of jump in one jump random process. The second type models transitions between credit ratings with the help of Mark's process. The main advantage of reduced models is that they do not require information about capital structure of the reference entity. Debtor's bankruptcy process is modelled as a random process of Poisson type. Among the most prominent authors who deal with the reduced credit risk models we include for example (Duffie & Singleton, 1999; Hull and White 2000, 2000b; Jarrow & Turnbull 1995; Jarrow & Protter 2004; Madan & Unal, 1998) and others.

Recently, new type of models had been developed. They are called hybrid models in specialized literature. This group of models is inspired by the elements of both structural and reduced models (Zhou, 2001).

During the second half of the 1990s, banks and consultants started developing credit risk models aimed at measuring the potential loss, with a predetermined confidence level, that a portfolio of credit exposures could suffer within a specified time horizon (generally one year). These were mostly motivated by the growing importance of credit risk management especially since the now complete Basel II. These Value at Risk (VaR) models include J.P. Morgan's - CreditMetrics®, Credit Suisse Financial Products' - CreditRisk<sup>+</sup>®. Genesis of credit models is pictured in Table 1.

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