Credit Risk Modelling:  
A Literature Overview Based on Market Models

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ABSTRACT

The assessment of businesses’ credit risk is a difficult and important process in the area of financial risk management. In a classical multivariate model, financial ratios are combined in order to achieve a credit risk score, which signals if a loan application is approved or discarded. Despite their good performance, the developed multivariate models using statistical methods have been widely criticized. They are based on models that use accounting data, which have the disadvantage of being static and so often fail to follow the changes in the economic and business environment. In recent years, market models (structural and reduced form models) have become popular among banks and financial institutions, because of their theoretical background and the use of updated information. The aim of this article is to present an overview of basic market models (structural models, reduced form models and market models used from credit institutions) together with their characteristics in order to outline their development throughout the last decades.

KEYWORDS

Credit Risk, Financial Institutions, Financial Risk, Market Models

1. INTRODUCTION

Credit risk is one of the major forms of risk and has become a central topic in finance. The increased interest for the measurement and management of credit risk is mainly due to the fact that the direct and indirect effects of default are particularly serious and directly related to long-term profitability and viability of companies and more generally of credit institutions. Especially the recent years the difficult economic situation has made banks more cautious in lending.

Accounting-based models are probably the most widely used ones. These scoring models combine key financial (accounting) and non-financial data into an aggregate index indicating the credit risk of the firms. Comprehensive reviews of this line of research can be found in Thomas (2000), Papageorgiou et al. (2008), and Abdou and Pointon (2011). Despite their success and popularity, the above credit scoring models are mostly static and they are based on historical accounting data which describe the current and past performance of a firm. This is a serious drawback, especially taking into account the rapid changes in the economic environment. The shortcomings of accounting-based credit scoring models have shifted the interest to other approaches, such as market models. The contribution of this study to the current literature, is the presentation of the main market models used the last decades together with their main characteristics in order to clarify the requirements of each one of them. It is
crucial for the researchers, to know in advance the shortcomings of each method. The above element is quite helpful in order to select the most appropriate model.

The usefulness of using market variables is attractive for several reasons:

- First, market prices reflect the information contained both in and out of the financial statements (Agarwal and Taffler, 2008), making them comprehensive for the prediction of corporate default.
- Secondly, the integration of market variables can significantly increase the forecasting ability of models, taking into account that financial statements are available on a quarterly basis, at best case (many studies use annual data), when market prices are available on a daily basis.
- Third, market prices could be more suitable for predicting default, as they reflect expected future cash flows (the annual accounts, in contrast, reflect past performance of the company).
- Fourthly, market variables can provide a direct estimate of volatility, a measure that could be a strong predictor of default and is not included in the financial statements. According to Beaver et al., (2005), the perception is that the higher the volatility, the greater the probability of default.

One of the first approaches towards integration of market data into credit risk modelling was the one of Black and Scholes.

The option pricing theory of Black and Scholes (1973) and Merton (1974) is consistent with the theory of capital structure of Modigliani and Miller (1958). The capital structure can be understood as an option. Thus, one can determine the value of a company’s equity to the underlying market value of the company.

In the case where the debt of a company consists of a single coupon with nominal value \( D \), which expires in a year, the company will have to make a payment equal to \( D \) in one year, otherwise it will become insolvent. From the above the following question arises: “Under which conditions will the company become insolvent regarding the payment of its debt?”. If the value of its asset worth more than \( D \), the company will pay its debt, whereas if the value of the assets is less than \( D \) the company would not pay its debt and will prefer to give its assets to the lender. More simply, the company will default its debt and equity will be useless if the assets worth less than \( D \) in one year, and the company will not default its debt and equity will worth the difference between the value of assets and \( D \), if assets worth more than \( D \) in one year.

In other words, the equity of the company is a call option on the assets of the company, where the exercise price and maturity are given by the face value and maturity of the debt.

An estimation of the equity of the company could be done, if the face value and the debt maturity period, the value of the assets today and the volatility of assets were known. In this case, the Black-Scholes model of option pricing could be used. For more complicated cases, the above model would not work, but a general approach to obtain a value for the equity of the company could be executed.

From the standpoint of creditworthiness analysis, the interesting point is that default may be regarded as a failure to exercise an option.

The following sections, present the development of market models, starting from Black-Scholes Merton model (section 2), moving to first and second generation structural models (section 3 and 4), following the presentation of reduced form models (section 5) and market models that are used from credit institutions (section 6). Section 7, summarizes the main characteristics of these models and proposes ways for further improvement.

2. BLACK-SCHOLES MERTON (BSM) MODEL

The option pricing model of Black and Scholes (1973) and Merton (1974) (hereinafter BSM) implies a direct link between equity prices and credit risk. Once the equity seen as a call option on the assets of a company, the probability of default can be extracted from the proximity of the value
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