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Quantification of credit risk with the use of CreditMetrics

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Abstract

The main aim of this paper is to present basic characteristics of CreditMetrics model and its model application. The importance of accurate credit risk quantification is growing nowadays in global economy just like in local economies. CreditMetrics approach is designed to measure the risk of credit loss caused by changes in the creditworthiness of borrowers. Loss does not occur only in the case of counterparty's default, but also upon its transition into worse rating category. The output of this model, however, is the entire distribution function of portfolio value. We will present application of this method for single bond. For this purpose we will use analytical method. We will use methods of formal logic such as: analysis, synthesis, deduction and comparison. The result will be comprehensive overview of CreditMetrics results under the conditions of local economy. We will also mention test results of various renowned agencies, which reflect the accuracy of this model.

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1. Introduction

CreditMetrics model is used to analyze and manage credit risk of investment instruments portfolio, unlike other models which are more specialized in the analysis of credit risk of individual investment instruments respectively credit risk of individual companies.

According to Adamko, Kliestik, Birtus (2014): Analysis of the entire portfolio is based on an assessment of the credit risk of individual instruments and subsequently applied to the portfolio by taking into account the cross-correlation of bonds. The model was created by the JP Morgan bank back in 1997. Since 1999, it became part of the credit risk management for almost all major banks. CreditMetrics model is constantly being developed and improved

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since its creation to become as flexible as possible to respond to market developments and regulatory requirements. This model belongs into category of market-to-market models, because it estimates default of the issuer on the basis of the rating changes. In practice, this model can be applied to comprehensive ranges composed of various investment instruments and not just on the bonds. According to Jaros et.al.(2014) development of each financial model play important role in turbulent global economy.

The structure of CreditMetrics model, consists of four parts. The first is called Value at Risk due to Credit and is an essential part of this model along with the second part Portfolio Value at Risk Due to Credit. The third part Correlations and fourth one Exposures are supporting ones. Together they reflect the risk of entire portfolio. It uses up-down approach, as it begins with quantification of the individual bonds risk and subsequently quantifies the risk of the entire portfolio. As it can be seen in the figure, first part of the three steps downs the risk of an individual bond by using standard deviation and percentiles. The second, third and fourth part are used to identify the credit risk of the portfolio as a whole. Part Three – correlation takes into account the cross-correlation values of the current bond prices. The aim for investors should be to diversify comprehensive ranges, that is, with the increasing number of bonds it should decrease the risk of the portfolio. Part Four - exposure - is particularly important for analyzing the credit risk of those instruments whose value has a high sensitivity to changes in market variables such as exchange rate or interest rate. Misankova et.al.(2014) wrote that good example are swaps. It is thanks to this part that CreditMetrics model is applicable in number of financial instruments and not just bonds.

This model works with a wide range of input data. The basic features are ratings of individual components of the portfolio and the migration matrix. Complex data is available for limited application of this model in a broad spectrum.

Credit Metrics aim is to determine the volatility of the value of a single bond or portfolio during the followed period of time with the help of standard deviation and to express credit risk in this way. The volatility in prices is caused by possible default or change in the rating. This means that the model has advantage, because it considers credit risk to be caused not only by default, but also by the risk of changes in the price of the financial instrument (bond) due to changes in the rating. It is also based on the assumption of a different distribution of market yields on credit.[†]

2. Credit Metrics method of calculating bond risk

The credit risk calculation of single bond is divided into four basic steps. The following calculation steps can be vividly seen in figure 1:

1. The bond rating and probability transition matrix.
2. Seniority bond, from which default rates were derived, respectively recovery rate.
3. The calculation of the bond present value for each rating category by forward curves with different credit spreads for each rating category.
4. The probability distribution of the current values of bond prices, from which were subsequently derived values of bond volatility expressed by using standard deviations or percentiles. Volatility of bond present value expresses credit risk of the bond.

This is followed by the calculation of credit risk itself with the use of procedure described in technical document model Credit Metrics published by RiskMetrics Group along with the fact that we use custom parameters of bonds and the document only covers the procedure. Credit Metrics model uses two calculation methods:

- analytical method
- Monte Carlo simulation, which, is used to estimate amount of needed economic capital while using the VaR method.

[†] Risk Metrics – Technical document - https://www.msci.com/resources/technical_documentation/CMTD1.pdf

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