

An application of the implied copula model to the risk evaluation of a portfolio

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Abstract

In this article, we propose a simple application of the implied copula model to the risk evaluation of a portfolio. The implied copula was proposed by Hull and White (2006) for pricing CDOs (Collateralized Debt Obligations), especially the synthetic CDOs. In the implied copula model, the hazard rates of the reference entities have a certain distribution, and the default times of the entities are assumed to be conditionally independent given the history of the hazard rates of all entities. Hull and White (2006) described the distribution of the hazard rates as a non-parametric manner, and calibrated the distribution numerically so that all the market prices of CDO tranches could be explained by the model. Their numerical examples showed that there existed a small probability mass in the extremely high default probability region, which implied the latent fear of the major market participants against catastrophic default events. Combining this implied copula model and a general framework for constructing a risk evaluation model proposed by Kijima and Muromachi (2000), we propose a simple and new risk evaluation model for a portfolio. For simplicity, we use the distribution functions of default times (the cumulative default probabilities) instead of the hazard rates. In order to construct a distribution of the future value of the portfolio, we need two different probability measures: the risk-neutral probability measure for pricing assets, and the physical probability measure for generating stochastic future scenarios. We impose some simple relations on the interest rate and default processes under these two probability measures, and under each measure, a similar stochastic structure is assumed to the implied copula model. Most of the previous risk evaluation models use mainly the historical data, but we use the historical data and the risk premiums included in the market prices so that our model could reflect the latent fear of the major market participants on the estimates of the risk measures. Our model might be used as a complementary tool to the existing risk evaluation models.