Paper Title:

Extreme Value Theory and mixed C-vine Copulas on modelling energy price risks

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Abstract

The understanding of joint return distributions is an essential part for portfolio risk management. Managing an asset portfolio is a non-trivial exercise. What makes this task non-trivial is the complex behaviour of each particular asset in the portfolio on one hand and the dependence structure between all portfolio constituents on the other side.

In this paper we are concerned with modelling the joint distribution of spot and futures electricity related portfolios by employing a mixed canonical vine copula model. The objective of this paper is threefold. First, we introduce the idea of mixed canonical copulas as an alternative and more flexible way of modelling the joint return distribution of energy related portfolios. Second, we propose an extension of extreme value theory in the context of vine copula modelling that takes into account the asymmetries both of the marginals and joint distribution. And finally, we compute risk measures (e.g. VaR, Expected Shortfalls) and discuss the implication of our modelling approach for passive and active risk management performance.

Our approach combines pseudo-maximum-likelihood fitting of GARCH models to estimate the conditional volatility, extreme value theory (EVT) for estimating each tail of the innovation distribution of the GARCH models and pair copula construction (canonical vine copula) for modelling the dependence structure of the portfolio constituents. Our main findings are that VaR estimates based on normality assumption are satisfactory for higher quantiles but poor for extreme quantiles. We show that our procedure gives better 1-day VaR estimates for lower quantiles than methods which ignore the heavy tails of innovations and the asymmetries of the joint return distribution. Moreover, we show that for inferences involving the tails, pair copula selection should not be based on likelihood-based criteria but rather on non-parametric dependence measures.
