Asset allocation to prevent unexpected large losses in an extreme value theory framework

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Extended abstract

The optimal portfolio choice problem was firstly addressed by Markowitz (1952), who defined a mean-variance model, assuming normally distributed returns and using variance as a risk measure. However, it is now widely accepted that the distribution of financial assets return is actually skewed and fat-tailed. Therefore, although the assumption of normality makes calculations easier, it underweights extreme events, and might lead to an optimistic asset allocation.

The aim of this work is to examine the optimal portfolio selection problem for a risk-adverse investor who wants to prevent large losses, minimizing a quantile-based risk measure (for large quantile α) under the Extreme Value Theory (EVT) framework.

In recent years, investors and risk managers have indeed become more concerned about extreme adverse conditions, due to recent financial crises and the new risk-based solvency requirements for banking and insurance sectors. Within this context, we apply EVT for modelling the tails of the returns, without the need to make any assumption on the underlying distribution of the observations. Indeed, EVT provides useful tools to describe the distribution of extreme realizations of a given distribution function, and to quantify the extremal dependence between markets via the analysis of associated dependence measures.

Moreover, using the variance as a risk measure is often inadequate: as it measures the spread of the distribution around the mean, it assigns the same weight to gains as well as losses and, concerning the central values, it could underestimate the extremes in presence of heavy-tailed distributions. Therefore in our work, we focus on quantile-based risk measures (in

particular on Var and Expected shortfall), which are more appropriate for safety-first investors whose primary goal is to guard against the occurrence of large losses. The identified optimal portfolio is then compared with the one obtained under the basic assumption of normally distributed returns.

Keywords
Optimal asset allocation; Fat-tailed distributions; Extreme Value Theory; Catastrophic risks.

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