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Alexandru V. Asimit, Jinzhu Li

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Extremes for Coherent Risk Measures

ALEXANDRU V. ASIMIT

*Cass Business School, City University London,
London EC1Y 8TZ, United Kingdom.*

E-mail: asimit@city.ac.uk

JINZHU LI¹

*School of Mathematical Science and LPMC,
Nankai University, Tianjin 300071, P.R. China.*

E-mail: lijinzhu@nankai.edu.cn

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Abstract. Various concepts appeared in the existing literature to evaluate the risk exposure of a financial or insurance firm/subsidiary/line of business due to the occurrence of some extreme scenarios. Many of those concepts, such as Marginal Expected Shortfall or Tail Conditional Expectation, are simply some conditional expectations that evaluate the risk in adverse scenarios and are useful for signaling to a decision-maker the poor performance of its risk portfolio or to identify which sub-portfolio is likely to exhibit a massive downside risk. We investigate the latter risk under the assumption that it is measured via a coherent risk measure, which obviously generalizes the idea of only taking the expectation of the downside risk. Multiple examples are given and our numerical illustrations show how the asymptotic approximations can be used in the capital allocation exercise. We have concluded that the expectation of the downside risk does not fairly take into account the individual risk contribution when allocating the VaR-based regulatory capital, and thus, more conservative risk measurements are recommended. Finally, we have found that more conservative risk measurements do not improve the fairness of the cost of capital allocation when the uncertainty with parameter estimation is present, even at a very high level.

Keywords and phrases: Capital allocation; Coherent/Distortion risk measure; Conditional Tail Expectation; Extreme Value Theory; Marginal Expected Shortfall; Rapid Variation; Regular Variation.

Mathematics Subject Classification: Primary 62P05; Secondary 62H20, 60E05.

1. INTRODUCTION

Let $(\Omega, \mathcal{F}, \mathbb{P})$ be a probability space and denote by $L_+(\mathbb{P})$ the set of non-negative random variables. Consider $X, Y \in L_+(\mathbb{P})$ two random insurance risks possessing *distribution functions (df)* F and G , respectively. The corresponding survival functions are $\bar{F} := 1 - F$ and $\bar{G} := 1 - G$. It is assumed

¹Corresponding author. Phone: +86-22-2350 1233.

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