How superadditive can a risk measure be?

Ruodu Wang[*], Valeria Bignozzi[†] and Andreas Tsanakas[‡]

January 27, 2014

Abstract

Portfolio diversification, as quantified by a risk measure, is intrinsically linked with the potential for superadditivity that the risk measure displays. In this paper, we study the extent to which any risk measure can lead to superadditive risk assessments. For this purpose we introduce the novel notion of extreme-aggregation risk measures. For a particular risk measure, the extreme-aggregation measure it induces characterizes its most superadditive behavior by yielding the worst-possible diversification ratio across dependence structures. For a wide range of risk measures, the induced extreme-aggregation measure corresponds to the smallest dominating coherent risk measure. In our main result, it is shown that the extreme-aggregation measure induced by a general distortion risk measure is a coherent distortion risk measure. Furthermore, the extreme-aggregation measure induced by a convex shortfall risk measure is a coherent expectile. These results show that, in the presence of dependence uncertainty, quantification of a coherent risk measure is often necessary, an observation that lends further support to the use of coherent risk measures in portfolio risk management.

---

[*]Department of Statistics and Actuarial Science, University of Waterloo, Canada. (email: `wang@uwaterloo.ca`)

[†]RiskLab, Department of Mathematics, ETH Zurich, Switzerland. (email: `valeria.bignozzi@math.ethz.ch`)

[‡]Cass Business School, City University London, UK. (email: `a.tsanakas.1@city.ac.uk`)