

## Measurement and Transfer of Catastrophic Risks. A Simulation Analysis

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### Abstract

When analyzing catastrophic risk, traditional measures for evaluating risk, such as the probable maximum loss (PML), value at risk (VaR), Tail VAR (TVaR), and others, can become practically impossible to obtain analytically in certain types of insurance, such as earthquake. Given the available information it can be very difficult for an insurer to measure this risk. The transfer of risk in this type of insurance is usually done through reinsurance schemes that can be of diverse types that can greatly reduce the extreme tail of the cedant's loss distribution. This effect can be assessed mathematically. The PML is defined in terms of a very extreme quantile. Also, under standard operating conditions, insurers use several "layers" of non proportional reinsurance that will be combined with some type of proportional reinsurance. The resulting reinsurance structures will then be very complicated to analyze and to evaluate their mitigation or transfer effects analytically it may be necessary to use alternative approaches, such as Monte Carlo simulation methods. This is what we do in this paper in order to measure the effect of a complex reinsurance treaty on the risk profile of an insurance company. We compute the pure risk premium, PML as well as a host of results: impact on the insured portfolio, risk transfer effect of reinsurance programs, proportion of times reinsurance is exhausted, percentage of years it was necessary to contract reinstatements, etc. Since the estimators of quantiles are known to be biased, we explore the alternative of using an Extreme Value approach to complement the analysis.

KEY WORDS: Quantile, Extreme Value, Monte Carlo Methods, PML, VAR, Reinsurance.