EGU24-6125, updated on 08 Aug 2024
https://doi.org/10.5194/egusphere-egu24-6125
EGU General Assembly 2024

Parametric insurance for hydropower: Comparing alternative schemes combining hydrologic and market data

Lorenzo Scarpellini, Andrea Ficchì, Matteo Giuliani, and Andrea Castelletti
Politecnico di Milano. Department of Electronics, Information and Bioengineering

The alteration in hydrological patterns due to climate change is causing a rise in the occurrence and severity of hydrological extremes like droughts and floods. This, in turn, is leading to conflicts over water resources and increasing financial risk for several economic sectors, such as hydropower and agriculture.
Parametric insurance is a tool for hedging financial risks that is already used for making water-related sectors more resilient. With respect to traditional loss-based insurance, parametric schemes are more flexible, simple and cost-effective, and they also minimize moral hazard and promote further adaptation efforts.
Parametric schemes rely on the definition of an index, correlated with revenue losses, and on predetermined thresholds to trigger payouts compensating for losses. Different conditions can be proposed to contract buyers, varying the payout structure, contract price (i.e., premium) and duration. For example, while in standard index-based insurance, a fixed premium is paid on an annual basis, in 'collar' contracts a premium is only paid in years when the index exceeds a pay-off threshold, i.e., when revenues are high. Indexes can also be designed in a variety of ways, but they should be highly correlated with losses, reliable and transparent. While simple indexes based on a hydrological variable are often preferred, multivariate indexes can, in some cases, be more suitable due to the multiple factors influencing revenue losses. This is the case for the hydropower sector, which is highly dependent on both hydrological and market variability. Different parametric insurance contract types have been proposed in the past for various sectors, but alternative schemes are seldom compared on the same system.

In this study, we investigate the mitigation of economic impacts deriving from droughts and energy market variability on hydropower companies by comparing alternative parametric insurance schemes. Such alternatives are built considering a variety of payout structures, including standard and collar schemes, and both univariate and multivariate indexes based on hydro-meteorological and market variables. We test our methodology on three hydropower operators in the Lake Como system, in the Italian Alps, an area where global warming has caused local temperatures to increase more than double the global average and stakeholders are increasingly exposed to drought risk.
Results show that the use of a multivariate index explicitly considering electricity prices greatly increases performance compared to a simpler univariate hydrological index. In addition, while both standard and collar contracts can effectively reduce revenue variability and improve revenue

floor, the collar contract can provide better performance at a lower price. However, such more complex contracts are more sensitive to parameter values and their calibration should be performed carefully.