

Title: Diversity–Risk–Price Interactions and Efficiency Performance in EU Fisheries

Abstract:

This paper examines the relationships between diversity, downside risk, price dynamics, and technical efficiency across 23 EU fisheries sub-ecosystems, each representing the fishing activity of a member-state within the broader EU marine ecosystem. Diversity is measured using the Berger–Parker, Simpson, Shannon, and Concentration Ratio indices, which capture species dominance, dependency, and structural resilience across sub-ecosystems and over time.

Downside risk is assessed through a left-tail financial indicator that estimates the probability of extreme negative outcomes in fisheries. This serves as a sub-ecosystem level proxy for the inherent risk in fishing activities, providing an empirical and probabilistic measure of worst-case losses, which is crucial for understanding the economic vulnerability of these fisheries. Risk is first computed at the species level within each sub-ecosystem and subsequently aggregated into a weighted sub-ecosystem risk measure. Analogous leader-risk and top-five weighted risk indicators are derived to evaluate whether vulnerability is concentrated in a small set of species or distributed across a wider portfolio.

Price dynamics constitute the economic dimension of the analysis. For each sub-ecosystem, we compute a weighted average landing price as an aggregate measure of its economic value, reflecting species composition and market relevance. Leader prices and top-five weighted prices are also calculated to assess value concentration and to determine whether economic performance is driven by a few high-value species or supported by a diversified structure.

Technical efficiency is evaluated using a Cobb–Douglas stochastic production frontier and a bias-corrected Data Envelopment Analysis (DEA) incorporating environmental variables. The DEA employs a double-bootstrap procedure to obtain consistent efficiency scores under both input- and output-oriented models.

A central objective of the study is to examine whether diversity, risk, prices, and efficiency differ significantly across sub-ecosystems and evolve over time. Using ANOVA and Kruskal–Wallis tests, we assess spatial and temporal heterogeneity in ecological conditions, economic valuation, and production performance. Theoretically, lower diversity increases concentration, dominance, and dependency on a small number of species, thereby raising ecological and financial vulnerability. Likewise, efficiency-enhancing strategies may reduce diversification, potentially amplifying revenue variability and downside risk. Our empirical results reveal marked differences in diversity, risk exposure, and price structures across EU fisheries, offering insights that contrast or align with theoretical expectations. These findings provide a basis for targeted policy interventions aimed at strengthening the long-term sustainability and economic stability of the fishing sector.

Keywords: Diversity; Downside Risk; Price Dynamics; Technical Efficiency; Fisheries Economics

JEL codes: Q22, Q57, Q01