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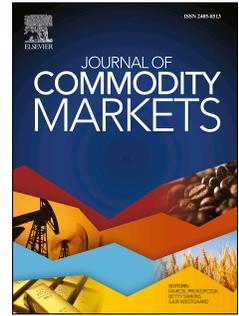
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Optimal Hedging Strategies for Salmon Producers

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Abstract

We study the optimal hedging decisions for a risk-averse salmon producer. The hedging decisions are determined using a multistage stochastic programming model. The objective is to maximize the weighted sum of expected revenues from selling salmon either in the spot market or in futures contracts and Conditional Value-at-Risk (CVaR) of the revenues over the planning horizon. The scenario tree for the multistage stochastic programming model is generated based on a procedure that combines Principal Component Analysis and state space modelling. We present results for 3 different CVaR percentiles and different degrees of risk-aversion. The results indicate that salmon producers should use futures contracts to hedge price risk already at fairly low degrees of risk-aversion. The methods described in this paper will be useful as a decision support tool for determining fish companies' risk management and hedging strategies.

1. Introduction

Global production of farmed Atlantic salmon has increased considerably over the past decades, from approximately 5300 tonnes in 1980 to almost 2.4 million tonnes in 2015. Throughout this period Norway has been the world's largest producer, with a production share of 54.7% in 2015 (FAO, 2017). The increase in production has been mainly driven by innovations leading to productivity growth and lower production costs, such as feeding technology or disease management. These innovations combined with a process of industrialization have made the salmon farming industry more similar to other food-producing industries (Kumar and Engle, 2016; Kvaløy and Tveterås, 2008; Asche, 2008).

Salmon producers face many types of risk. Among Norwegian producers, future salmon prices, diseases, as well as various regulatory issues have been identified as the most important sources of risk (Bergfjord, 2009). The regulatory framework is defined through a political process that cannot be controlled by an individual producer. Diseases are part of the production risk that is to

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