Indifference pricing of natural gas storage contracts

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Natural gas markets are incomplete due to physical limitations and low liquidity, but most valuation approaches for natural gas storage contracts assume a complete market. We propose an alternative approach based on indifference pricing which does not require this assumption but entails the solution of a high-dimensional stochastic-dynamic optimization problem under a risk measure. To solve this problem, we develop a method combining stochastic dual dynamic programming with a novel quantization method that approximates the continuous process of natural gas prices by a discrete scenario lattice. In a computational experiment, we demonstrate that our solution method can handle the high dimensionality of the optimization problem and that solutions are near-optimal. We then compare our approach with rolling intrinsic valuation, which is widely used in the industry, and show that the rolling intrinsic value is sub-optimal under market incompleteness, unless the decision-maker is perfectly risk-averse. We strengthen this result by conducting a backtest using historical data that compares both trading strategies. The results show that up to 40% more profit can be made by using our indifference pricing approach.

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