Project

Option Calibration and Pricing (HJM multifactor)

Computational Finance AY 2023-2024

You are asked to calibrate an HJM model on German electricity swaps and price structured pay-offs options by means of Monte Carlo simulation.

The DataDEEEX file contains all liquid maturities for the German power swaps and the options prices (implied volatility quotes) on the 4Q24 swap (monitoring period over the fourth quarter of 2024 with delivery at the end date) on the 4th of November 2023. The OIS calibrated discount factors are available in the sheet ois.

1. Consider an HJM model for the 4Q24 German power swap driven by two Brownian motions (i.e. 6.9 in Benth 2008 with p=2 and n=0). Consider constant What is the admissible range for the model parameters?
2. Can you write explicitly the condition on the drift (i.e. without using numerical integration)?
3. Calibrate the model on the 4Q24 German option prices (the entire surface) by minimizing the distance between model and market prices. Comment on the quality of the calibration.
4. Calibrate the model on the 4Q24 German option prices by considering a generic time-dependent . Why only the integral of for t that goes from 0 to the time to maturity is relevant?
5. Calibrate the model on the 4Q24 German option prices by considering a generic time-dependent and . Do you notice a significant improvement wrt. case iv?
6. Try to repeat the calibration (for just the point iv) by using a deterministic time-dependent volatility function chosen by you.
7. Price a down and in call option with maturity 6 months with strike K=500 and barrier with the model calibrated in iii, iv and in v. Does a closed formula exist in any of the three cases? Do the three prices differ significantly? If yes which one do you trust the most?

Benth, Fred Espen, Jurate Saltyte Benth, and Steen Koekebakker. *Stochastic modelling of electricity and related markets*. Vol. 11. World Scientific, 2008.