Pricing vulnerable options under cross-asset Markov-modulated jump-diffusion dynamics

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Abstract

In this study, the dynamics of the underlying asset price and the counterparty's asset price are governed by a cross-asset Markov-modulated jump-diffusion (MMJD) model that captures the time-inhomogeneity and systematic cojumps. Additionally, the forward interest rate processes are driven by a Markov-modulated Heath–Jarrow–Morton model to depict stochastic volatilities. Under an incomplete-market setting, we apply the Markov-modulated Esscher transform technique to determine a riskneutral martingale measure. After determining the Markov-modulated Esscher parameters, we obtain an integral expression on the prices of vulnerable European-style Black–Scholes options. The numerical illustrations indicate that the findings are consistent with Klein (1996) and contribute to the extant literature on cojumping impacts on vulnerable option prices.