Stochastic Volatility's Orderly Smiles

Julien Guyon Bloomberg, USA

Abstract:

We consider multi-factor stochastic volatility models and derive the volatility smile at order two in the volatility-of-volatility. At this order, the smile is quadratic in logmoneyness and depends on three effective quantities within which the dynamics of the spot and forward variances of any particular model is condensed. We supply explicit expressions of these quantities for a family of Heston-like models as well as a 2-factor version of the Bergomi model. For this model, comparison with the exact smiles shows good agreement for volatility-of-volatility levels that are typical of equity underlyings. Finally we derive short term asymptotics and highlight the structural dependence of the level of ATM skew and curvature on the ATM volatility, and we link the decay of ATM skew and curvature for long maturities to the time decay of spot/variance and variance/variance covariance functions.