

Kris Jacobs: “The Shape and Term Structure of the Index Option Smirk: Why Multifactor Stochastic Volatility Models Work so Well” (with P. Christoffersen and S. Heston)

Abstract:

State-of-the-art stochastic volatility models generate a "volatility smirk" that explains why out-of-the-money index puts have high prices relative to the Black-Scholes benchmark. These models also adequately explain how the volatility smirk moves up and down in response to changes in risk. However, the data indicate that the slope and the level of the smirk fluctuate largely independently. While single-factor stochastic volatility models can capture the slope of the smile, they cannot explain such largely independent fluctuations in its level and slope over time. We propose to model these movements using a two-factor stochastic volatility model. Because the factors have distinct correlations with market returns, and because the weights of the factors vary over time, the model generates stochastic correlation between volatility and stock returns. Besides providing more flexible modeling of the time variation in the smirk, the model also provides more flexible modeling of the volatility term structure. Our empirical results indicate that the model improves on the benchmark Heston model by 15% in-sample and 11% out-of-sample. The better fit results from improvements in the modeling of the term structure dimension as well as the moneyness dimension. We also find that a two-factor model with one persistent factor provides the best out-of-sample fit, and improves on the Heston model by 19%. This finding illustrates that parameter parsimony is critical to ensuring satisfactory out-of-sample performance.