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Derivative pricing with Non-Gaussian GARCH Models and their Diffusion Limits

We investigate the weak convergence of a non-Gaussian GARCH model together with an application to the pricing and hedging of European style options determined using different stochastic discount factors (SDF), such as discrete-time Girsanov transformations and exponential affine SDFs. Applying these changes of measure to asymmetric GARCH models sampled at increasing frequencies, we obtain risk neutral families of processes which converge to the same bivariate diffusion, which is no longer a standard Hull-White stochastic volatility process. Additionally, it differs from the one obtained by applying the standard minimal martingale measure in continuous time to the diffusion limit of the GARCH family of processes under the physical measure. We show that for skewed innovations, this risk neutral diffusion limit exhibits a non-zero market price of volatility risk which is proportional to the market price of the equity risk, where the constant of proportionality depends on the skewness and kurtosis of the underlying distribution. Our theoretical results are further supported by extensive numerical simulations.