On convexity adjustments for stock derivatives due to stochastic repo margins

Repo transactions are of high relevance for functioning financial markets, among others as they are a necessary tool for short selling. Short selling in turn is necessary for hedging, in particular for the hedging of stock derivatives. Most mathematical models in this context assume the repo margins to be constant for reasons of tractability. However, in reality those rates are stochastic and highly correlated with the development of the underlying stock. The aim of the present article is to investigate the impact of this feature on stock derivative pricing, respectively the error caused by ignoring this effect. For this purpose, it is shown how to incorporate a reasonable stochastic model for the repo margin into a stock price process. We adopt an idea from 1.5-factor credit-equity models to create a reciprocal relationship between stock price and repo margin, as observed in the marketplace. The result is a convexity adjustment for all kind of stock derivatives, which is ignored when the repo margin is modeled constantly. A concrete formula for the density of the stock’s log-return can be found within a repo-enhanced Black-Scholes model. Similar as in the case of Asian option pricing, the involved mathematical techniques rely on well-known results for Yor’s process and the
Hartman-Watson law.

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