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Forward starting options pricing with double stochastic volatility, stochastic interest rates and double jumps

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Abstract

We present an extension of double Heston stochastic volatility model by introducing CIR stochastic interest rate and double exponential jumps in the stock price process. We derive the characteristic function and forward characteristic function of the log asset price and thereby forward starting options are well evaluated by the COS method. We also provide efficient simulation of the proposed model and Monte Carlo solutions for forward starting options based on the QE scheme. Numerical results show that the COS method is fast and efficient for pricing forward starting options.

Keywords: Forward starting options; COS method; Double exponential jumps; Stochastic interest rates; Double Heston model

1. Introduction

Forward starting options are the options which commence at some time in the future with an expiration further at some specified future date. They are the building blocks of cliquet options which are very popular in the world of equity derivatives. Stochastic volatility models fit the empirical implied volatility surface for long expirations fairly well [1]. Lucié [2], Kruse and Nögel [3] priced forward starting options under the Heston stochastic volatility model [4]. However, stochastic volatility models including the Heston model are inconsistent with the short-dated term structure of skew [5]. Two extensions have been present in some literatures. One is to add jumps

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