Derivative Pricing on a Threshold Mean-reverting Model with an Averaging Variable

Hoi Ying WONG, Fangyuan DONG (the speaker)

Department of Statistics, The Chinese University of Hong Kong

Corresponding speaker. Tel.: +852 3943 8522

E-mail address: adadong17@gmail.com

Postal address: R126, LSB, CUHK, Shatin, NT, HKSAR

Abstract:

While mean reversion is a well-documented feature in interest rate and commodity prices, empirical studies show that the long-term mean level and the mean reversion rate are not persistent in time. Mean reversion with regime switching has drawn a greater attention in recent empirical and theoretical research. This paper introduces a threshold Cox–Ingersoll–Ross (TCIR) model to so that a regime shift is determined endogenous by the underlying financial asset instead of an exogenous Markov-modulated process. We derive the moment generating function (MGF) of an averaging variable following the TCIR model by imposing several boundary and continuity conditions. The MGF enables us to value various kinds of derivatives using the Euler algorithm and the Laplace transform. We apply the result to zero-coupon bond, longevity bond and fixed-strike Asian option. Our empirical show that interest rate, longevity rate and commodity prices exhibit threshold mean reversion feature. As their values should stay positive, it offers empirical support to TCIR model. Numerical examples confirm the accuracy of our analytical solution by benchmarking against the Monte Carlo simulations and demonstrate the generation of implied volatility smile.

Keywords:

Mean reversion, Threshold, Moment generating function, Longevity bond, Asian option