Optimal Investment of Variance-Swaps in Jump-Diffusion Market with Regime-Switching

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Abstract

We consider a general jump-diffusion market with regime-switching where the jump risk is modeled as a Markov-modulated Poisson random measure. In this incomplete market, we price the variance-swaps using a combination of the Esscher transform and change of measure on time-inhomogeneous Markov chains. We study the dynamic optimal investment problem of the variance-swaps and characterize the optimal feedback strategy. Moreover, a closed-form solution to the HJB PDE associated with the stochastic control problem is established and the verification theorem is proved. The numerical analysis based on a two-state Markov chain uncovers some robust features of the optimal investment strategy.

Keywords and phrases: Jump-diffusion; Regime-switching; Variance swaps; Optimal investment.

JEL Classification: G11; D9

1 Introduction

Since the seminal work of Merton [19], portfolio optimization problems have been the subject of a considerable number of investigations. In recent years, Markovian regime-switching models have received considerable attention from both academic researchers and market practitioners in economics and finance. The parameters or coefficients of regime-switching models can change over time caused by the transition of market states which is in general described as a continuous time Markov chain with finite states. The extended portfolio optimization problems on various default-free and defaultable financial securities under the regime-switching model have been developed. Elliott and Siu [12] investigate an optimal portfolio selection problem in a regime-switching Black-Scholes market when an economic agent faces model uncertainty. Zhang et al. [23] obtain closed-form solutions for the optimal portfolio strategies when the price of securities was modeled by geometric Markovian jump processes. Capponi and Figueroa-Lopez [6] consider the dynamical portfolio optimization problems with default risk under regime-switching. Shen and Siu [20] study a consumption-portfolio optimization problem in a hidden Markov-modulated asset pricing model with multiple risky assets under the situation that an economic agent only has access to information about the price processes of risky shares. We also here emphasize some more recent works which

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