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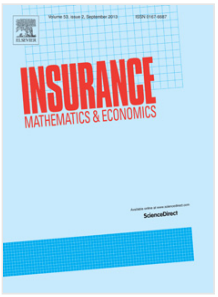

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Time-consistent reinsurance-investment strategy for a mean-variance insurer under stochastic interest rate model and inflation risk

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Abstract

In this paper, we consider the time-consistent reinsurance-investment strategy under the mean-variance criterion for an insurer whose surplus process is described by a Brownian motion with drift. The insurer can transfer part of the risk to a reinsurer via proportional reinsurance or acquire new business. Moreover, stochastic interest rate and inflation risks are taken into account. To reduce the two kinds of risks, not only a risk-free asset and a risky asset, but also a zero-coupon bond and Treasury Inflation Protected Securities (TIPS) are available to invest in for the insurer. Applying stochastic control theory, we provide and prove a verification theorem and establish the corresponding extended Hamilton-Jacobi-Bellman (HJB) equation. By solving the extended HJB equation, we derive the time-consistent reinsurance-investment strategy as well as the corresponding value function for the mean-variance problem, explicitly. Furthermore, we formulate a precommitment mean-variance problem and obtain the corresponding time-inconsistent strategy to compare with the time-consistent strategy. Finally, numerical simulations are presented to illustrate the effects of model parameters on the time-consistent strategy.

Keywords: Reinsurance and investment; Mean-variance criterion; Time-consistent strategy; Stochastic interest rate; Stochastic inflation index; Stochastic control

1. Introduction

Reinsurance and investment are two important issues for an insurance company. Reinsurance can protect insurers against potentially large losses, while investment enables insurers to achieve his/her management objectives. Therefore, many optimization problems about reinsurance and investment with various objectives have risen in recent years. For example, Hipp and Plum (2000), Schmidli (2002) and Promislow and Young (2005) investigated the optimal reinsurance and investment problem for an insurer in the sense of minimizing the ruin probability. For the objective of expected utility maximization, Cao and Wan (2009) studied the optimal proportional reinsurance and investment problem of maximizing the expected exponential and power utilities from terminal wealth. Lin and Yang (2011) considered an insurer whose surplus process was governed by a jump-diffusion risk process and obtained the optimal reinsurance-investment strategy to maximize the expected exponential utility from terminal wealth. Liang and Bayraktar (2014) discussed the optimal reinsurance and investment problem in an unobservable Markov-modulated compound Poisson risk model. Besides, mean-variance criterion becomes another popular objective in literature of optimal reinsurance and investment problems, see Bäuerle (2005), Delong and Gerrard (2007) and Bai and Zhang (2008). Traditional mean-variance optimization problem is a time-inconsistent problem where an optimal solution obtained at a time is no longer optimal as time goes forward into a future point, and the Bellman's principle of optimality does not hold. Since time-consistency is important for a rational decision maker, more and more researches develop the time-consistent

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