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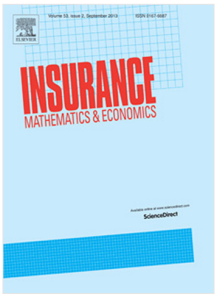

Optimal surrender strategies and valuations of path-dependent guarantees in variable annuities

Junkee Jeon, Minsuk Kwak

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Optimal surrender strategies and valuations of path-dependent guarantees in variable annuities

Junkee Jeon* Minsuk Kwak†‡

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Abstract

In this paper, we consider variable annuity contracts with guaranteed minimum maturity benefits in which the embedded guarantees can be surrendered any time before the maturity date has been reached. We derive the optimal surrender strategies and the values of three different types of guarantees embedded in VA contracts: (1) constant guarantees, (2) constant guarantees with an up-and-out barrier, and (3) path-dependent guarantees with a lookback feature. The valuation of the embedded guarantees with a surrender option can be formulated as a free boundary problem, and we can obtain a corresponding non-homogeneous partial differential equation (PDE). We apply the Mellin transform to the non-homogeneous PDE in order to obtain an integral equation that produces the value of the embedded guarantee as well as the optimal surrender boundary in a variable annuity contract. We present the properties of the fair fee rate and the optimal surrender strategy with numerical examples.

JEL Classification Codes: C63, G12, G22

Keywords: Variable annuities; Path-dependent guarantee; Optimal surrender strategy; Free boundary problem; Mellin transform

*E-mail: junkeejeon@khu.ac.kr, Department of Applied Mathematics, Kyung Hee University, Korea.
†E-mail: mkwak@hufs.ac.kr, Department of Mathematics, Hankuk University of Foreign Studies, Korea.
‡Corresponding author.

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