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The pricing of dynamic fund protection with default risk

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Abstract
In over-the-counter markets, many options on a defaultable instrument are subject to default risks stemming from the possibility that the option writer may not carry out its contractual obligations. In this study, we examine the valuation of dynamic fund protection with an issuer’s credit risk. By using double Mellin transforms and the method of images, we obtain the closed-form solution of vulnerable dynamic fund protection. Moreover, we analyze the value of dynamic fund protection under the default risk of firms with respect to the model parameters and demonstrate that our closed-form solution has been derived accurately and efficiently by comparing it with the solution from the Monte-Carlo simulation.

Keywords: dynamic fund protection, vulnerable option, default risk, double Mellin transform

1. Introduction

Equity-indexed annuities (EIAs) have been an interesting product for many investors since their first launch by Keyport Life Insurance Co. in 1995. EIAs are complex financial instruments that have both fixed and variable annuities. They represent an alternative savings plan for conservative investors, as their earnings rate is closely related to an equity index. Because their returns change more than a fixed annuity, but not as much as a variable annuity, EIAs involve higher risk (but more potential return) than a fixed annuity, but lower risk (and less potential return) than a variable annuity. EIAs also provide a minimum guaranteed interest rate combined with an interest rate linked to a market index. Because of this guaranteed interest rate, EIAs have the potential to earn higher returns than traditional fixed annuities when the stock market is increasing.

Further, EIAs offer a minimum guaranteed return when low returns exist in the stock market. Specifically, the rate of return for an EIA is determined by the maximum of the minimum guaranteed return and the earnings rate of the stock price. Generally, investing directly in stocks or mutual funds involves high risk, whereas investing in bonds or fixed deposits generates a very low earnings rate. Indeed, EIAs were first introduced to resolve the weaknesses of traditional derivatives. They have therefore been attractive financial securities for moderately conservative investors trying to avoid high risks but achieve moderate returns. In addition, for the past decade, they have been regarded as the most innovative financial derivatives in the US insurance industry. Since EIAs provide investors with a minimum guaranteed return at an expiration date, they may become more complicated derivatives than other financial instruments. In particular, option pricing theory has become an excellent tool for enhancing the pricing method of EIAs because of their implicit option structure. Mitchell and Slater 1996 and Tiong 2000 provided more detailed illustrations of EIAs.

In 2000, the concept of dynamic guarantee or protection, which is an application of EIAs, was proposed by Gerber and Pafumi 2000 and Gerber and Shiu 2003a. Dynamic fund protection (DFP) can be seen as an extended put option since the seller offers continuous protection to guarantee that the balance of the investor’s account does not dip below
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