Guarantee valuation in Notional Defined Contribution pension systems

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Abstract

The notional defined contribution pension scheme combines pay-as-you-go financing and a defined contribution pension formula. The returns on contributions are calculated using a notional rate that reflects the financial health of the system and which is linked to an external index set by law, such as the growth rate of GDP, average wages, or contribution payments [4]. However, the volatility of this rate may introduce a pension adequacy problem in the system and therefore guarantees may be needed. Here we focus on the guarantee of a minimum return on the contributions made to the pension scheme and we calculate its price by means of option pricing [5]. In pay-as-you-go financed pension system we face the problem that we guarantee returns based on assets which cannot be traded, due to their unfunded nature. This problems leads to contingent claim valuation in incomplete markets. In this context uniqueness of a risk-neutral measure is not assured and individual risk preference has to be introduced [1]. In this paper we use the theory of utility indifference pricing [2] to obtain a closed-form solution for the price of the guarantee under exponential utility and with presence of stochastic interest rates [3]. The idea is to price the option on the untraded asset by using as a proxy a traded asset which is correlated to it. The obtained formulae are used to value different return guarantees on a notional defined contribution pension scheme.

Keywords: Pension Mathematics, Guarantees, PAYG, Utility indifference pricing, Incomplete markets

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