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A performance analysis of participating life insurance contracts

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ABSTRACT

Participating life insurance contracts are one of the most important products in the European life insurance market. Even though these contract forms are very common, only very little research has been conducted in respect to their performance. Hence, we conduct a performance analysis to provide a decision support for policyholders. We decompose a participating life insurance contract in a term life insurance and a savings part and simulate the cash flow distribution of the latter. Simulation results are compared with cash flows resulting from two benchmarks investing in the same portfolio of assets but without investment guarantees and bonus distribution schemes, in order to measure the impact of these two product features. To provide a realistic picture within the two alternatives, we take transaction costs and wealth transfers between different groups of policyholders into account. We show that the payoff distribution strongly depends on the initial reserve situation and managerial discretion. Results indicate that policyholders will in general profit from a better payoff distribution of the participating life insurance compared to a mutual fund benchmark but not compared to an exchange-traded fund benchmark portfolio.

1. Introduction

As a consequence of the financial crisis, private investors currently seek safe investments with low downside risks. In this context, minimum interest rate guarantees embedded in financial products are one option for investors. Insurance companies offer investment products with such a downside protection and are often perceived as a safe harbor.[2] Participating life insurance (PLI hereafter) is one of the most important products in the life insurance sector with a built in minimum interest rate guarantee. In most European countries, these contracts are typically characterized by an embedded term life insurance, a cliquet-style interest rate guarantee,[3] and bonus participation rules with regard to the insurer's reserve situation (surplus fund). However, administrative costs and complex profit distribution schemes between policyholders and shareholders make it difficult to measure the performance of this product from the policyholder's point of view. We model PLI based on contract forms offered in the German market[4] and simulate the complete payoff distribution on an ex ante basis. Subsequently, we compare the cash flow distribution of the PLI with two passive portfolios which invests into the same assets. We show how the payoff distribution depends on the initial reserve situation (the surplus fund in our model) and management's discretion.

The characteristics of PLI contracts make it difficult to measure their performance. A PLI embeds various (explicit and implicit) options as well as complex bonus distribution schemes between policyholders and shareholders. In addition, an insurance company's management has a certain discretion with respect to some parameters. Furthermore, wealth transfers between different groups of policyholders take place. In order to get over these difficulties, we measure the performance of PLI contracts from an ex ante perspective while taking embedded options, bonus distribution, and management's discretion into account. We empirically calibrate our model with market data and simulate various insurance collectives to incorporate wealth transfer effects.

In previous research on PLI, we can distinguish between two major streams of literature. The first one addresses fair pricing of participating life insurance policies based on option

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[2] For example, in the German life insurance market, the estimated increase in premium income in 2009 is 4.8% compared to 0.8% in 2008 (see GDV, 2009, Beitragseinnahmen der Versicherungswirtschaft, accessed January, 2010 at http://www.gdv.de/Downloads/Pressemeldungen_2009/Tabellenanhang_PM_2009.pdf). This increase might be mainly attributable to an increased risk aversion and/or risk awareness following the financial crisis.

[3] In case of a cliquet-style interest rate guarantee, the guaranteed rate of interest has to be credited to the policyholders' account on a year-to-year basis.

[4] However, the contract forms in focus are very similar to PLI contracts offered in other European insurance markets.

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pricing theory. Amongst others, bonus distribution rules are often modeled and reproduced in this area of research (see, for example, Grosen and Jørgensen (2000), Bacinello (2001), Hansen and Miltersen (2002), Haberman et al. (2003), and Kling et al. (2007)). For instance, Kling et al. (2007) analyze the numerical impact of interest rate guarantees found in PLI contracts on the shortfall probability of a life insurance company. Gatzert (2008) provides a general framework for pricing and risk management of participating life insurance contracts under different assumptions in respect to asset management and surplus distribution strategies. Gatzert and Schmeiser (2008) assess, in particular, the risk of different premium payment options typically offered in participating life insurance contracts. However, these fair pricing approaches generally only work under the assumption of perfect and frictionless markets.

The second stream of literature mainly analyzes performance by means of the internal rate of return, accounting ratios, and similar performance ratios based on historical cash-flows or numerical examples provided by insurance companies (see, e.g., Ferrari (1968) and Levy and Kahane (1970)). However, these approaches generally ignore embedded options and do not consider the risk-return profile of the investment. Exceptions are Waldow (2003) and Stehle et al. (2003). In these contributions, not only one single performance ratio is derived, but also historical cash flows of PLI contracts are compared with those of an alternative portfolio composed of an annual term life insurance and different investment products. Nevertheless, as most of these performance analyses are conducted from an ex post perspective, they can only indicate whether PLI contracts were advantageous in the past. Implications for the future, however, are limited.

In order to get a clear picture of the performance of PLI, we decompose PLI in a term life insurance and an investment part and simulate the cash flow distribution of the investment part under the real world measure $\mathbb{P}$. Further, we create two benchmark portfolios based on the same underlying to measure the impact of the interest rate guarantee and the bonus distribution rules on the cash flows of the portfolio. By calibrating our model with empirical market data, we are able to show in which cases the interest rate guarantee and the mechanisms applied by the insurance company can be beneficial to the policyholder. In addition, we show how the payoff distribution depends on the initial reserve situation and management's discretion. We do not benchmark the PLI using a fair (risk-neutral) pricing approach, which would mean to compare the observed market price with the calculated fair price, because we believe that the underlying assumption of perfect and frictionless markets is rather not fulfilled in this context. We doubt that instruments exist that enable policyholders to replicate the PLI's cash flows. We think that consumers will rather judge products depending on personal preferences and actually available alternatives.

The contribution of this paper is that we neither rely on a single performance measurement ratio nor do we provide an ex post analysis. Instead, our framework allows a comparison of the complete payoff distribution on an ex ante basis. This general framework is subsequently not bonded to one specific subjective preference scheme. Further, we model an insurance company with various insurance collectives in order to incorporate wealth transfer effects between different groups of policyholders. Only Hansen and Miltersen (2002) analyzed PLI with pooled accounts before, but just for a two-policyholders case. In addition, the influence of the initial level of the pooled surplus fund on the performance of one single contract is analyzed. Furthermore, we examine how management's discretion, in terms of a change of the target rate of return, affect the payoff distribution.

Results indicate that all of the elements we incorporate have a strong impact on payoffs and should subsequently not be neglected. We find that if the initial level of the surplus fund is high, a PLI contract will in general yield a better payoff distribution compared to the mutual fund (MF hereafter) benchmark but not compared to the exchange-traded fund (ETF hereafter) benchmark portfolio.

The remainder of the paper is organized as follows: In Section 2, we introduce our general framework. Results from Monte Carlo simulations are discussed in Section 3. We conclude in Section 4.

2. Model framework

2.1. Premium investments on a single contract basis

First, we illustrate an insurance company which has only one single insurance contract. We employ a discrete time model with $t \in \{1, \ldots, T\}$ where t determines the elapsed time since inception of the contract (in years) and T denotes the contract's maturity. In Section 2.5, the mechanism introduced for the single contract company is applied to an insurer with more than one contract. Our model builds on PLI contracts offered in Germany, but could be easily applied to similar regulatory frameworks (e.g., Switzerland or Austria).

The policyholder pays a constant annual premium P_{t-1} at the beginning of each year given no previous termination of the contract by death or surrender. The insurance company uses the amount $P_{c,t-1}$ of the annual premium to cover its costs. Costs are divided into annual operational costs and acquisition costs. The latter are allocated over the first five years of the contract. Another part of the premium $P_{r,t-1}$ is needed to cover the term life insurance. The remaining amount of the annual premium $P^{(\mathrm{PLI})}_{s,t-1}$ is invested in an asset portfolio. This savings part of the premium $P^{(\mathrm{PLI})}_{s,t-1}$ features an annual minimum interest rate r_g and builds up the policyholder's savings account $A_{g,t-1}$. The process can be modeled as

$$A_{g,t-1} = \sum_{i=1}^{t} P^{(\mathrm{PLI})}_{s,i-1} \exp\left(r_g(t-i)\right), \tag{1}$$

where

$$P^{(\mathrm{PLI})}_{s,t-1} = P_{t-1} - P_{c,t-1} - P_{r,t-1}. \tag{2}$$

The premium $P_{r,t-1}$ is the annual premium for a term life insurance contract. We calculate this premium using actuarial fair premiums and market loadings. To account for a decreasing sum insured I_t (also referred to as net amount at risk), the term life insurance premium is annually adjusted so that the sum insured equals the guaranteed death benefit D minus the accumulated savings account[5]:

$$I_t = D - \exp(r_g) A_{(g,t-1)}. \tag{3}$$

Given the probability q_{x+t} of a $(x+t)$-years old individual to die within the next year and based on Eq. (3), we calculate the annual risk premium as

$$P_{r,t-1} = q_{x+t-1} I_t \exp(-r_g), \tag{4}$$

under the assumption that payouts only take place at the end of each year.[6] Thereby, the guaranteed death benefit D equals the guaranteed terminal payment as common in most PLI contracts,

$$D = A_{g,T-1} \exp(r_g). \tag{5}$$

[5] Note that the premium in t will not be paid if the policyholder dies or surrenders between $t-1$ and t. Hence, we take the savings account in $t-1$ which increases by the guaranteed rate of interest between $t-1$ and t, i.e., $\exp(r_g) A_{(g,t-1)} = A_{(g,t)} - P^{(\mathrm{PLI})}_{s,t}$.

[6] We provide more details on the calculation of the risk premium in the appendix.