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# Participating Life Insurance Contracts under Risk Based Solvency Frameworks: Increasing Capital Efficiency by Product Design

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## Motivation, Purpose and Importance

Traditional participating life insurance products establish a main pillar of old-age provision products in Continental Europe and in other countries. These products typically come with a guaranteed benefit at maturity, which is calculated using some guaranteed minimum interest rate. Furthermore the clients receive a yearly surplus participation that depends on the performance of the insurer's assets. With so-called cliquet-style guarantees, once such surplus has been assigned to the policy at the end of the year, it increases the guaranteed benefit based on the same guaranteed minimum interest rate. This product design can create significant financial risk.

Briys and de Varenne (1997) were among the first to analyze the impact of interest rate guarantees on the insurer's risk exposure. However, their object of investigation was a simple point-to-point guarantee where surplus (if any) is credited at maturity only. The financial risks of cliquet-style guarantee products have e.g. been investigated in Kling, Richter, Russ (2007) where the shortfall risk of the insurance company is addressed, and in Graf, Kling, Russ (2011) where a risk minimizing asset portfolio is discussed by reference to different risk measures like the shortfall probability or the relative expected shortfall. Under risk based solvency frameworks such as Solvency II, the risk analysis of interest rate guarantees becomes even more important. Under these frameworks, the capital requirement is derived from a market-consistent valuation accounting for the risk an insurer takes. Hence, the aim of this paper is a comprehensive risk analysis of participating life insurance products with a particular focus on the impact of product design.

Our analyses show that traditional cliquet-style participating life insurance products lead to very high capital requirements. Therefore, we introduce products with modified types of guarantees which reduce the insurer's shortfall risk and profit volatility as well as the capital requirements under risk based solvency frameworks. In order to compare different product designs from an insurer's perspective, we develop and discuss the concept of "Capital Efficiency" which relates profit to capital requirements. We identify the key drivers of capital efficiency which are then used in our analyses to assess different product designs. The concept of "Capital Efficiency" and the analyses of different product designs should be of high significance for insurers, researchers, and regulators to identify sustainable life insurance products.

## Content of the paper and expected results

The paper is structured as follows:

In Section 1 we motivate the purpose of our research and clarify the challenges traditional participating life insurance products are currently confronted with, particularly in a capital market environment with low interest rates and high volatilities. Furthermore, we give a comprehensive literature overview.

In Section 2, we present the analyzed products that come with the same amount of guaranteed maturity benefit but with different types of guarantee:

- 1) a traditional contract with a cliquet-style guarantee
- 2) a contract where – besides the initial interest rate guarantee – it is guaranteed that the total value of the policyholder's account is locked in every year
- 3) a contract consisting only of the initial interest rate guarantee, that means the total value of the policyholder's account is allowed to decrease if the asset performance drops extremely. In spite of the different types of guarantees, all the products include a profit participation depending on the insurer's return on assets. Here we model the profit participation requirements given in German insurance laws. That means in particular that at least 90% of the investment income has to be distributed to the policyholders.

We will finally explain the mechanisms of the different products using deterministic scenarios. This helps create a better understanding of the differences in product design and how they affect the insurer's risk. In Section 3, we present the stochastic model. We start with an explanation of the management rules for the considered insurance company and explain how the evolution of the insurance portfolio and the insurer's balance sheet are simulated. We also introduce our asset model. The considered asset allocation consists of equities and bonds with different maturities. The underlying stock return and short rate processes are simulated using a correlated Black-Scholes and Vasicek model.

Based on the quantitative capital requirements of solvency regulations such as Solvency II we propose feasible measures for the assessment of the key drivers of capital efficiency in practical use. In Section 4, we present the numerical results. We can show that the modified products are significantly more capital efficient in terms that they rigorously reduce the financial risk, and therefore the capital requirements, although in most scenarios they provide the same maturity payment to the customer. The asymmetry, i.e. particularly the heavy left tail, of the insurer's profit distribution is tremendously reduced by the modified products. This leads to a reduction of the so-called Time Value of Options and Guarantees, a very important indicator for the insurer's risks resulting from options embedded in insurance contracts.

## References

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