Asset Allocation in Life Insurance

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Executive Summary

Insurance companies have two main sources of income: one is the underwriting income and the other is financial income from investment in capital markets. For life insurance products which have a saving component, the investment result of the insurer is an integrated part of the products and influences the bonus allocated to the policyholders. Therefore, the asset allocation decision is a very important topic for both life insurer and policyholders.

Asset allocation of a life insurance company is different from asset allocation of an investor with asset-only focus. As we know, the asset portfolio of a life insurer is optimized against the liability. The liability of a life insurer is complicated since it has embedded options linked with the life products. How to include options into the strategic asset allocation decision and how the asset allocation decision and risk-return profile will change is discussed in this paper.

In this paper, a specific kind of life insurance product, the with-profit product is used to analyze the impact of options included into the liability. The with-profit policy offers a minimum interest rate guarantee as well as a bonus credited to the policyholder's account. The bonus depends on the performance of the reference portfolio. By writing a with-profit policy, the insurer actually writes an option to the policyholders, the underlying of which the reference portfolio is.

The purpose of this paper is to optimize the asset portfolio against liability, where options will be introduced first on the liability side and then on the asset side. The following questions are discussed in this paper:

- How will the efficient frontier react if options are introduced on the liability side?
- How different is the optimal allocation from the optimal allocation in the case where only "guaranteed cash flow" is modeled in the liability?
- Will the efficient frontier be improved if options are modeled in the liability?
- Will the efficient frontier be improved if options are also introduced on the asset side?
- Is the risk level to benefit from the improvement of the efficient frontier bearable for insurers?

In the analysis of the optimal asset allocation problem for a with-profit business line, first liability will be modeled. Liability is modeled in three ways: Model I uses the "guaranteed cash flow" approach where only the guaranteed cash flows of with-profit products will be considered. Model II models options directly on the liability side and model III is the same as

model II except that the underlying reference portfolio for liability options is different. In the portfolio optimization problem, a Monte Carlo simulation is used to simulate the stochastic path equity return and the fixed income indices. We try to minimize the 99% expected shortfall of the surplus given a certain expected surplus return, further constraints on investment limits and a constraint to match asset and liability duration.

Our analysis shows that by modeling call options in the liability of with-profit products, the surplus efficient frontier will catch the loss if the asset expected return is lower than the guaranteed rate. The optimal asset portfolio will give more weight to the riskier assets to match the extra liability exposure of the call options. This leads to a shift of the minimum risk portfolio to a higher risk region. Call options in the with-profit product are linked to a reference portfolio. The choice of the reference portfolio has an influence on the optimal portfolio. For a medium risk level, choosing a reference portfolio with short duration will help to improve the efficient frontier slightly. At a high risk level, the benefit of modeling options in the liability disappears. The analysis also confirms that adding an equity option which is used to hedge guaranteed cash flows into the asset portfolio will improve the risk-return profile of the surplus.

Finally, ethical aspects about financial products linked to the mortality risk and longevity risk will be discussed. Ethical problems arising from selling and producing such products will be illustrated and possible regulatory measures will be suggested.

In general, adding options to the liability can help life insurers to better understand their liability and risk exposure. Depending on a life insurers' risk capacity, it can bring benefit to include options into the strategic asset allocation problem. Overall, including options to the liability shows an efficient frontier which is not worse than the efficient frontier where only guaranteed cash flows are modeled in the liability.