Institute of Insurance Economics

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Managing Parameter Risk for Life Insurance Embedded Options: The Role of Volatility Target Strategies

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Agenda

1. Problem Formulation
2. Example of Volatility Parameter Risk
3. Volatility Target Mechanism
4. Simulation and Pricing Challenges
5. The Effects of Volatility Targeting
6. Economic Implications

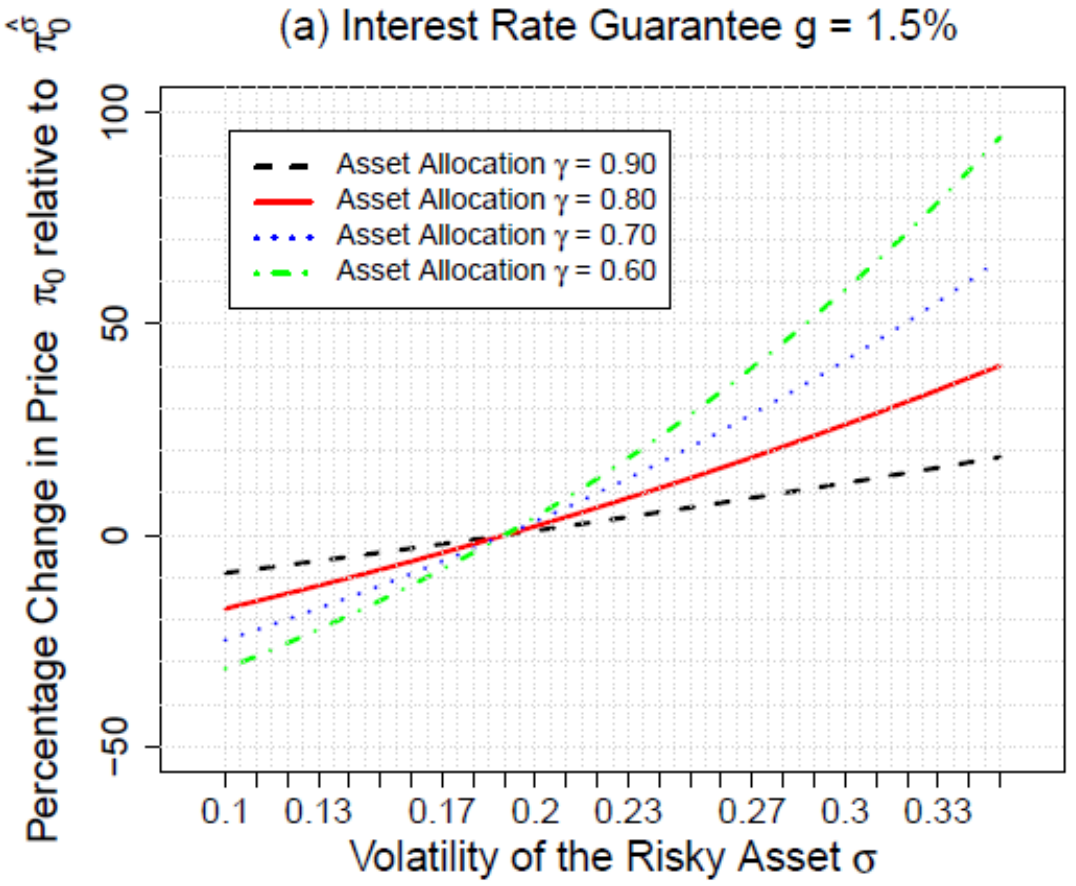
The workings of Life Insurance Options of Cliquet-Style

$$P_t = P_{t-1} \cdot \left[1 + max\left(g, \alpha\left(\left(\frac{V_t}{V_{t-1}} - 1\right)\right)\right)\right]$$

Annual Return of the Insurer's Assets

- The volatility of the underlying has a strong impact on the price of the cliquet option (Black-Scholes Market)
- In contrast to classical option types, the insurance company has control over the development of the underlying

Example of Volatility Parameter Risk



An asset allocation that takes volatility into account could be a solution

How to Construct a Volatility-Target Strategy

1. Specify the volatility target level σ_{tar}

2. Define time steps for rebalancing (e.g. weekly, monthly, quarterly etc.)

3. Determine an estimate for next period's volatility $\hat{\sigma}_t^{5y}$ (e.g. the 5-year historical volatility, etc.)

4. Specify the weight parameter γ_t for the next period:

$$\gamma_t = max\left\{1 - \frac{\sigma_{tar}}{\hat{\sigma}_t^{5y}}; 0\right\}.$$

Simulation and Pricing Challenges

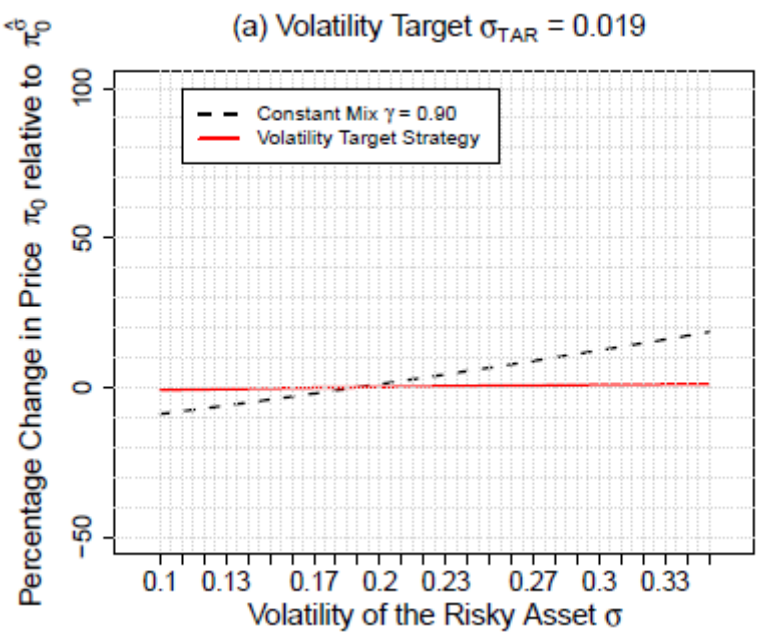
1 If the volatility estimate is based upon historical volatility realizations, the stochastic differential equation loses its Markovian property.

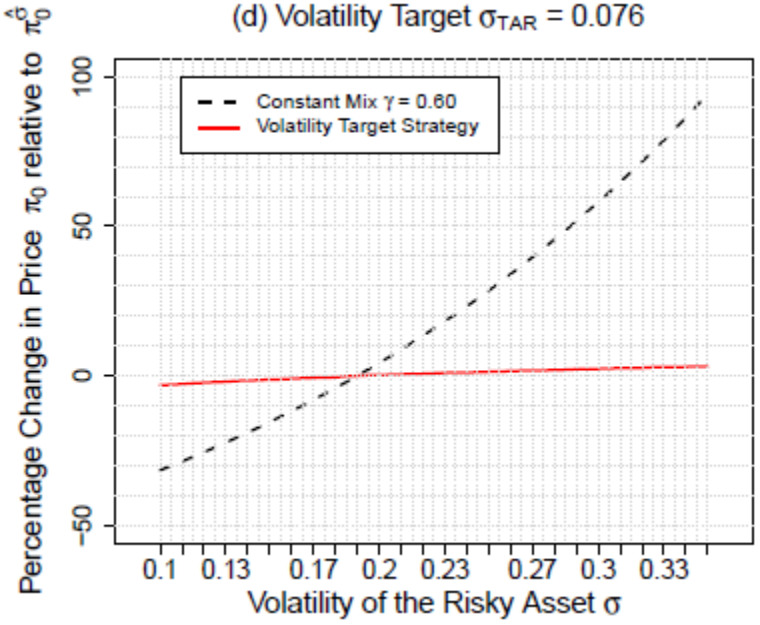
2 Therefore you are faced with a Stochastic Delayed Differential Equation, which is in general difficult to implement in Monte-Carlo simulations.

Solution A Markovian approximation of the Stochastic Delayed Differential Equation resolves the above issues

A detailed mathematical analysis can be found in "Assessing target volatility strategies using stochastic delayed differential models" by Lorenzo Torricelli (LMU Munich)

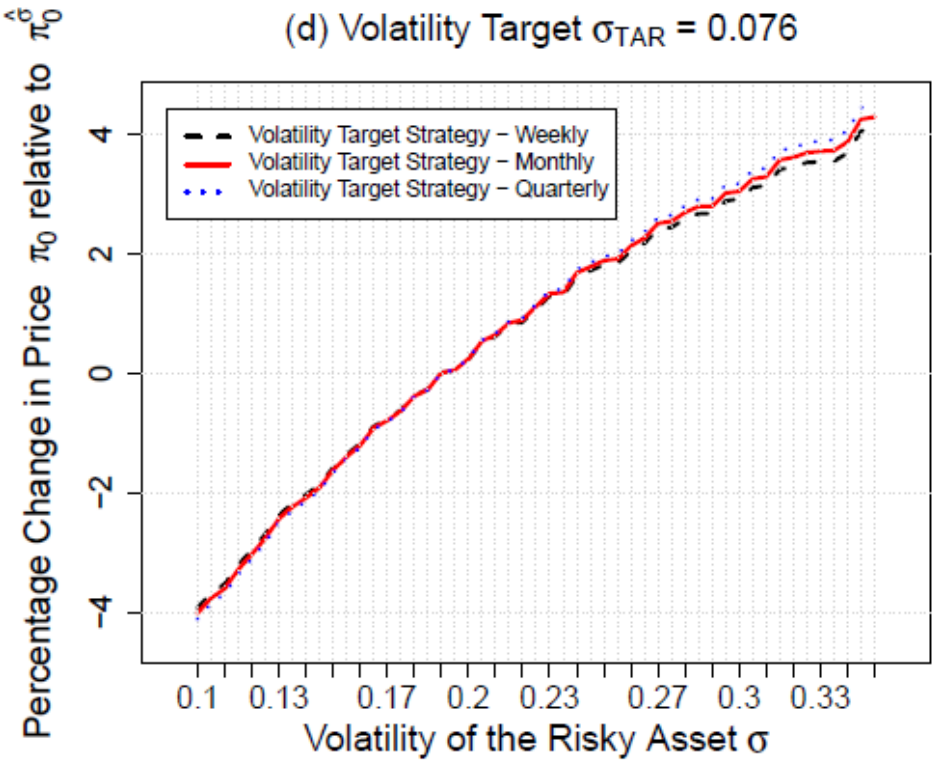
The Effects of Volatility Targeting





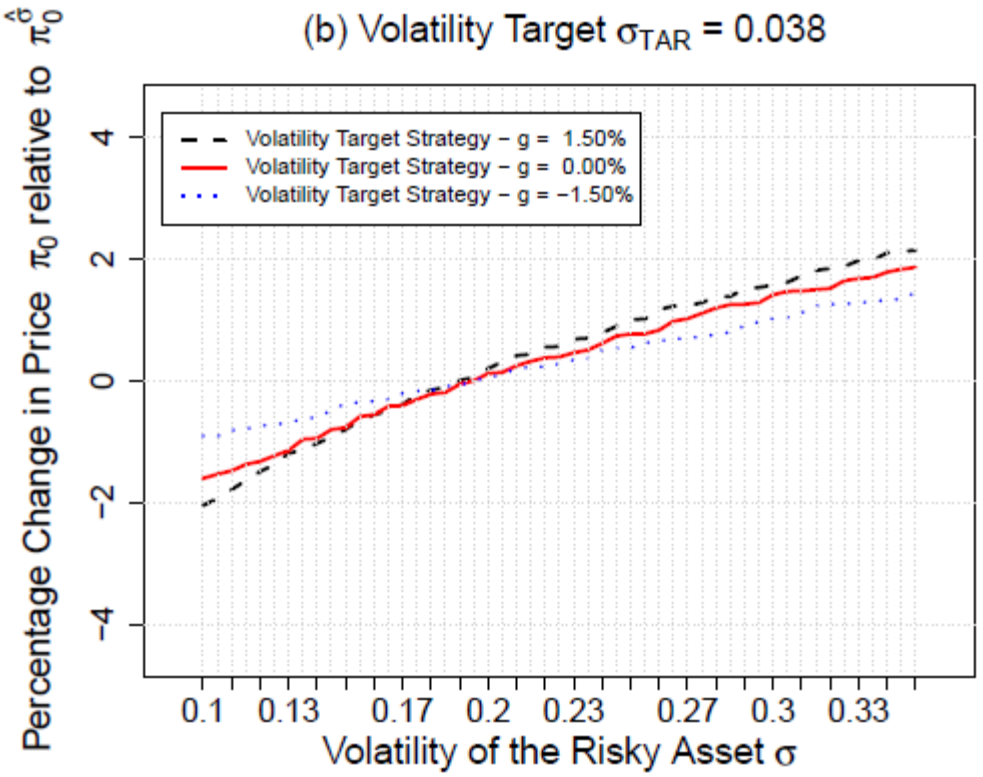
The option's sensitivity to volatility changes is severely reduced

Impact of the Rebalancing Frequency



Even quarterly rebalancing achieves the desired affect

Impact of the Interest Rate Guarantee Level



The higher the guarantee level, the more sensitive is the option to volatility changes

Economic Implications

1. A life insurer can utilize a volatility target strategy as a basic component of their asset liability management to substantially reduce their exposure to volatility parameter risk.

2. This approach also mitigates the parameter risk a policyholder incurs with respect to the true volatility of the model and, therefore, increases the attractiveness of the product.

3. In a model with only one source of risk and two assets, the asset allocation is completely defined by the volatility target mechanism. However, in the practical application with many different asset a volatility target mechanism could be implemented without putting heavy strains on the overall asset allocation strategy.

4. The implementation of a volatility target would also have a number of positive effects on the pricing of the embedded option. An estimation of the volatility parameter would not be needed for the pricing of the option.