Guaranteed Minimum Surrender Benefits and Variable Annuities: The Impact of Regulator-Imposed Guarantees

Alexander Kling, Frederik Ruez and Jochen Ruß
Research purpose

– Variable annuities are fund-linked annuities
  • the policyholder typically pays a single premium, which is invested in one or several mutual funds
  • several guarantee riders available on top of this
– “Guaranteed Minimum Accumulation Benefits” (GMAB)
  • the policyholder is guaranteed a minimum accumulation value at maturity of the contract
  • in return for this guarantee, the insurer receives guarantee fees deducted from the policyholder’s fund assets
  • typical product designs in case of surrender pay out the fund value
– In some countries: “Guaranteed Minimum Surrender Benefits” (GMSB) imposed by the regulator / consumer protection laws
  • in case of surrendering the contract, the policyholder is guaranteed to receive at least a certain minimum surrender benefit

⇒ combination of financial risk and policyholder behavior risk that can be difficult to hedge
Research questions

– The focus of this paper lies on the risk stemming from guaranteed minimum surrender benefits in the context of GMAB riders. Its key question is:

What is the impact of different types of GMSB on pricing and risk of GMAB riders within variable annuities?

• How much more expensive does the product become, if the regulator imposes minimum surrender benefits?

• What is the magnitude of potential losses if the regulator during the life of the contract changes minimum surrender benefits?

• What is the magnitude of potential losses if (additionally) assumptions about future policyholder behavior prove to be wrong?
Considered product design of the variable annuity

– policyholder pays single premium at inception of the contract
– GMAB
  • at maturity, the policyholder gets at least 100% of the single premium back
  • during the contract period, the insurer receives guarantee fees as a fixed percentage of the account value
  • periodically (in our analysis monthly), the policyholder has the opportunity to surrender the contract (1% surrender fee)

– pricing of the guarantee: contract is considered “fair”, if at inception, the value of future guaranteed benefits equals the value of future guarantee fees
  ➔ determines the guarantee fee
Surrender value of the contract – Considered models

1) **Surrender value = fund value (No GMSB)**
   - base case, case without GMSB
   - future guaranteed benefits / guarantee fees are not taken into account

2) **Surrender value = fund value + “market-consistent value” of the GMAB (if positive) (MCV)**
   - using market-consistent assumptions for interest rates and (implied) volatilities for valuation

3) **Surrender value = fund value + approximation of this “market-consistent value” (MCV proxy)**
   - following some approach suggested by the German actuarial association

4) **Surrender value = maximum of fund value and discounted guaranteed maturity value (Discount)**
   - discounted with a technical interest rate, which is set when the contract is concluded and will not change with changing market interest rates
Market model used for pricing, hedging and simulation

- interest rate model: Cox–Ingersoll–Ross (1985)
  - one-factor short-rate model
- equity model: Heston (1993)
  - stochastic volatility model
- no spreads / no transaction costs
- no correlation between interest rate process and equity processes
Policyholder behavior – Considered models

1) **No surrender (No Surr)**

2) **Deterministic behavior (Det Surr)**
   - each year, a deterministic but time-dependent percentage of the policyholders surrender their contracts

3) **Moneyness approach (Moneyness)**
   - practitioner’s approach
   - use deterministic behavior as base
   - determine factor between 1/3 and 5 depending on the ‘moneyness’ of the guarantee
   - we use the ratio between surrender value and the NPV of the guaranteed maturity value as ‘moneyness’

4) **Optimal (financially rational) behavior (Rational)**
   - approximated via Least-Squares-MC approach (Longstaff-Schwartz, 2001)
Analysis

Purpose:

– analyze the impact of different types of GMSB on pricing and risk of GMAB riders within variable annuities by calculating
  • fair guarantee fees if GMSB are taken into account at pricing
  • mispricing / loss if GMSB are not taken into account at pricing but included later

Approach:

– simulate a homogeneous pool of policies
  • use one of the considered behavior models for projection of the surrender behavior of the policyholders

– simulate the hedging portfolio of the insurer
  • insurer receives guarantee and surrender fees
  • uses delta-only hedging (monthly rebalancing)
    – Greeks are calculated using the insurer’s assumptions on future policyholder behavior and on financial markets
Main assumptions

Contract parameters

- Time to maturity: 15 years
- 50 year old male insured
- GMAB = single premium paid
- 1% surrender fee

Capital market

- mean reversion level of the short-rate process: 3%
- mean reversion level of the volatility process: 20%
Selected results – Pricing

- Fair guarantee fee for different assumptions about policyholder behavior and GMSB

<table>
<thead>
<tr>
<th>Behavior</th>
<th>GMSB</th>
<th>No GMSB</th>
<th>MCV</th>
<th>MCV proxy</th>
<th>Discount</th>
</tr>
</thead>
<tbody>
<tr>
<td>No surr</td>
<td>2.4%</td>
<td>2.4%</td>
<td>2.4%</td>
<td>2.4%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Det surr</td>
<td>1.0%</td>
<td>2.8%</td>
<td>2.4%</td>
<td>2.3%</td>
<td></td>
</tr>
<tr>
<td>Moneyness</td>
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<td>3.7%</td>
<td>3.6%</td>
<td>3.5%</td>
<td></td>
</tr>
<tr>
<td>Rational</td>
<td>4.9%</td>
<td>4.9%</td>
<td>4.9%</td>
<td>6.0%</td>
<td></td>
</tr>
</tbody>
</table>

- as expected, distinct differences between the analyzed behavioral models and the considered GMSB models in the resulting fair guarantee fee
  - if priced correctly, the product may become very expensive, up to a degree where the product might no longer be marketable
Selected results – Hedging / Risk

- Pricing assumptions
  - deterministic policyholder behavior
  - No GMSB
    ➜ fair guarantee fee = 1.0%
- Mispricing / loss as a percentage of the single premium paid if GMSB are not taken into account at pricing but included later

<table>
<thead>
<tr>
<th>GMSB</th>
<th>Det surr</th>
<th>Moneyness</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCV</td>
<td>-9.1%</td>
<td>-9.1%</td>
</tr>
<tr>
<td>MCV proxy</td>
<td>-5.4%</td>
<td>-6.7%</td>
</tr>
<tr>
<td>Discount</td>
<td>-4.8%</td>
<td>-6.5%</td>
</tr>
</tbody>
</table>

- GMSBs make the product much riskier for the insurer
  - even with behavior assumed correctly, the product bears a significant loss potential under all considered GMSB models
Thank you for your attention!

Alexander Kling  
[Email](a.kling@ifa-ulm.de)

Frederik Ruez  
[Email](frederik.ruez@uni-ulm.de)

Jochen Ruß  
[Email](j.ruß@ifa-ulm.de)