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

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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 the value of the contract at inception equals the single premium
  - value of future guaranteed benefits = 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 Germany 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 model for the variance process
- 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 perform full surrender
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

Capital market

- Long term interest rate assumptions: 3%
- Fund volatility (mean reversion level of the Heston process): 20%

Main findings – Pricing

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

Behavior / GMSB	No GMSB	MCV	MCV proxy	Discount
No surr	1.8%	1.8%	1.8%	1.8%
Det surr	0.8%	2.1%	1.8%	1.8%
Moneyness	1.9%	2.8%	2.7%	2.7%
Rational	3.6%	3.9%	4.8%	4.9%

- 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

Main findings – Hedging / Risk

- Pricing assumptions
  - deterministic policyholder behavior
  - No GMSB
  - ➔ fair guarantee fee = 0.8%
- Mispricing / loss as a percentage of the single premium paid if GMSB are not taken into account at pricing but included later

GMSB	Det surr	Rational
MCV	-7.6%	-8.2%
MCV proxy	-4.3%	-6.2%
Discount	-4.3%	-6.3%

- 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!

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