



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 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

	GMSB	No GMSB	MCV	MCV proxy	Discount
Behavior					
No surr		2.4%	2.4%	2.4%	2.4%
Det surr		1.0%	2.8%	2.4%	2.3%
Moneyness		2.5%	3.7%	3.6%	3.5%
Rational		4.9%	4.9%	4.9%	6.0%

- 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

GMSB	Det surr	Moneyiness
MCV	-9.1%	-9.1%
MCV proxy	-5.4%	-6.7%
Discount	-4.8%	-6.5%

- 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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