Institut für Finanz- und Aktuarwissenschaften

ifa

Measuring Profitability from a Shareholder Perspective

joint work with Stefan Graf, Alexander Kling and Andreas Reuß

- Karen Rödel

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- Munich, July 2019

Agenda

Motivation

Solvency II

Computation of the SCR

Balance sheet: Local GAAP vs. Solvency II

Cost of capital

Numerical results

Model framework

Simulation under $\mathbb{Q}$

Conclusion

Motivation

Main questions

- How can we compare products in terms of their profitability? What are **suitable indicators**?
- What kind of life insurance products are profitable to shareholders **under a Solvency II framework**?

Product	Payoff at maturity
maturity guarantee	$\text{Premium}\, e^{r_G T} + \delta_m \text{Premium} \left(e^{\sum_{i=1}^{T} \zeta_i} - e^{r_G T} \right)^+$
cliquet guarantee	$\text{Premium}\, e^{\sum_{i=1}^{T} (r_G + \delta_c (\zeta_i - r_G)^+)}$
unit-linked, no guarantee	$\text{Premium}\, e^{\delta_u \sum_{i=1}^{T} \zeta_i}$

Motivation

We can check the **pricing** of the products.

- Best estimate liability **(BEL)**: market-consistent valuation of future cash flows (e.g. by risk-neutral valuation)
- Present value of future profits **(PVFP)**: value of shareholder cash flows; at time zero: single premium – BEL

Is PVFP the quantity we are looking for?

It is **not sufficient**!

- Under Solvency II, companies have to comply with the solvency capital requirement **(SCR)**.
- The SCR is partly covered by shareholder capital.
- However, shareholders do not provide their capital for free. They expect a corresponding return.

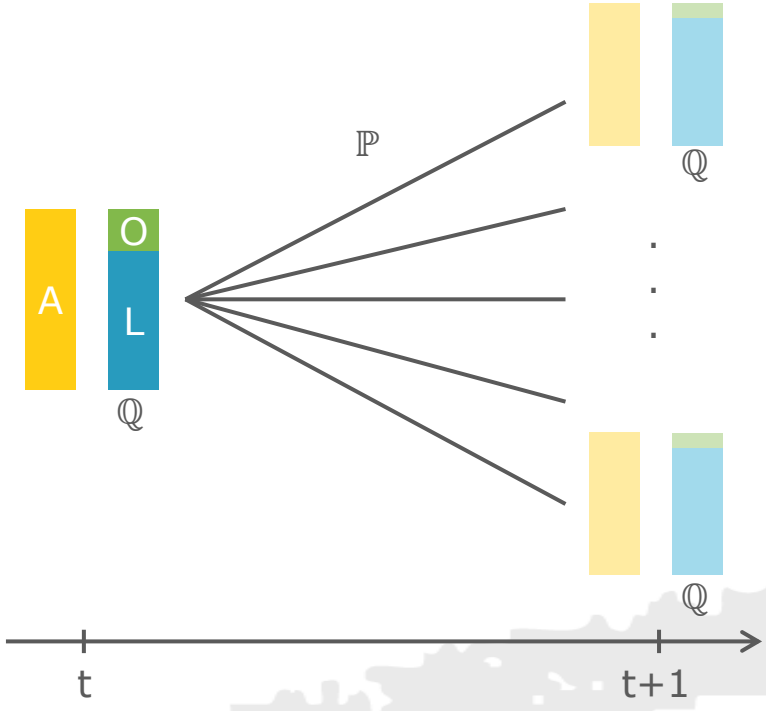
In addition to considering **PVFP**, we need to **check how much shareholder capital is bound** and for how long.

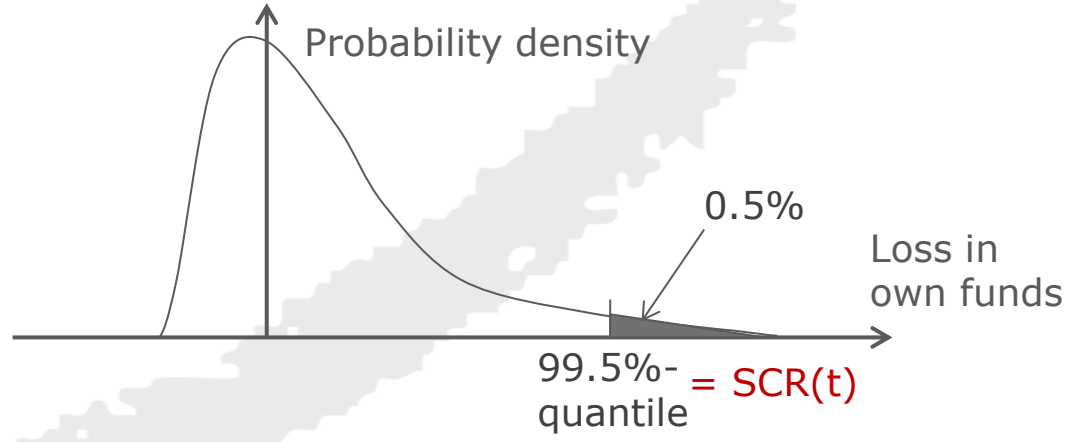
Solvency II

Computation of the SCR

Definition of the SCR

"It shall correspond to the Value-at-Risk of the basic own funds of an insurance or reinsurance undertaking subject to a confidence level of 99,5 % over a one-year period." (art. 101 framework directive)





A	= assets
O	= own funds
L	= liabilities
SCR	= Solvency Capital Requirement

Solvency II

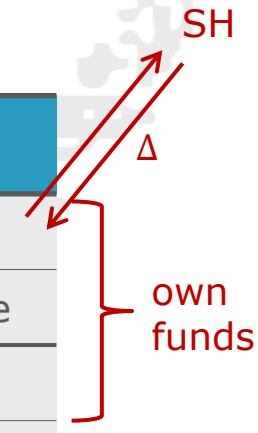
Balance sheet: Local GAAP vs. Solvency II

Local GAAP (HGB)

Assets	Liabilities
assets	SH capital
	surplus reserve
	mathematical reserve

Solvency II

Assets	Liabilities
assets	SH capital
	surplus reserve
	PVFP
	BEL



Cost of capital

We include the **loss from having capital bound** in the company through a cost of capital approach:

$$coc = \sum_{t=0}^{T-1} e^{-\int_0^{t+1} r(s)ds} \left(e^{coc\_rate} - 1\right) (\text{SH capital})_t$$

- we need SH capital and SCR for each point in time → very complex, high computational effort

Then, we compare this figure with **shareholder cash flows**:

$$profit\ beyond\ coc = \sum_{t=0}^{T} e^{-\int_0^{t} r(s)ds}\ \Delta_t - \sum_{t=0}^{T-1} e^{-\int_0^{t+1} r(s)ds} \left(e^{coc\_rate} - 1\right) (\text{SH capital})_t$$

- **under** $\mathbb{Q}$: we get the market-consistent value by taking the expectation
- **under** $\mathbb{P}$: analysis of real-world paths leads to a probability distribution
  - "= 0": returns are just enough to compensate for having capital bound
  - ">0/<0": returns are higher/lower than the cost of capital

Numerical results

Model framework

work in progress

Financial market

- stochastic interest rates: Hull-White model
- stock process: geometric Brownian motion

Product specification

- time to maturity: $T = 20$
- guaranteed interest rate: $r_G = 0\%$
- contract value: $BEL_0 = 100$
- pricing: $Premium = 110 \implies PVFP_0 = 10$
- cost of capital rate: $coc\_rate = 0.06$

Investment strategy

Assets	Liabilities
money market	SH capital
	surplus reserve
90% money market, 10% stocks	PVFP
	BEL

Numerical results

Simulation under $\mathbb{Q}$: 3000 paths

work in progress

	maturity		cliquet		unit-linked	
participation factor	0.46		0.42		0.70	
SCR_0	25.71		30.82		10.60	
initial balance sheet	money market 15.71	SH capital 15.71	money market 20.82	SH capital 20.82	money market 0.6	SH capital 0.6
		surplus reserve 0		surplus reserve 0		surplus reserve 0
	90% MM, 10% stocks 110	PVFP 10	90% MM, 10% stocks 110	PVFP 10	90% MM, 10% stocks 110	PVFP 10
		BEL 100		BEL 100		BEL 100
$\mathbb{E}[coc]$	19.78		22.94		4.25	
$\mathbb{E}[profit\ beyond\ coc]$	−10.19		−13.48		5.45	

Conclusion

How to assess **shareholder profitability**:

- check the **pricing**: How high is the PVFP?
- check the **SCR**: How much capital is bound and for how long? **(cost of capital approach)**
- compare the cost of capital with shareholder cash flows

In our simplified model,

- interest rate guarantees are very expensive due to high capital requirements (SCR)
- the cliquet guarantee is even less profitable than the maturity guarantee

Note that we are still at the beginning of our analysis. We want to further understand how all the different components of our model interact.

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Contact information

Karen Rödel
+49 (731) 20644-237
k.roedel@ifa-ulm.de

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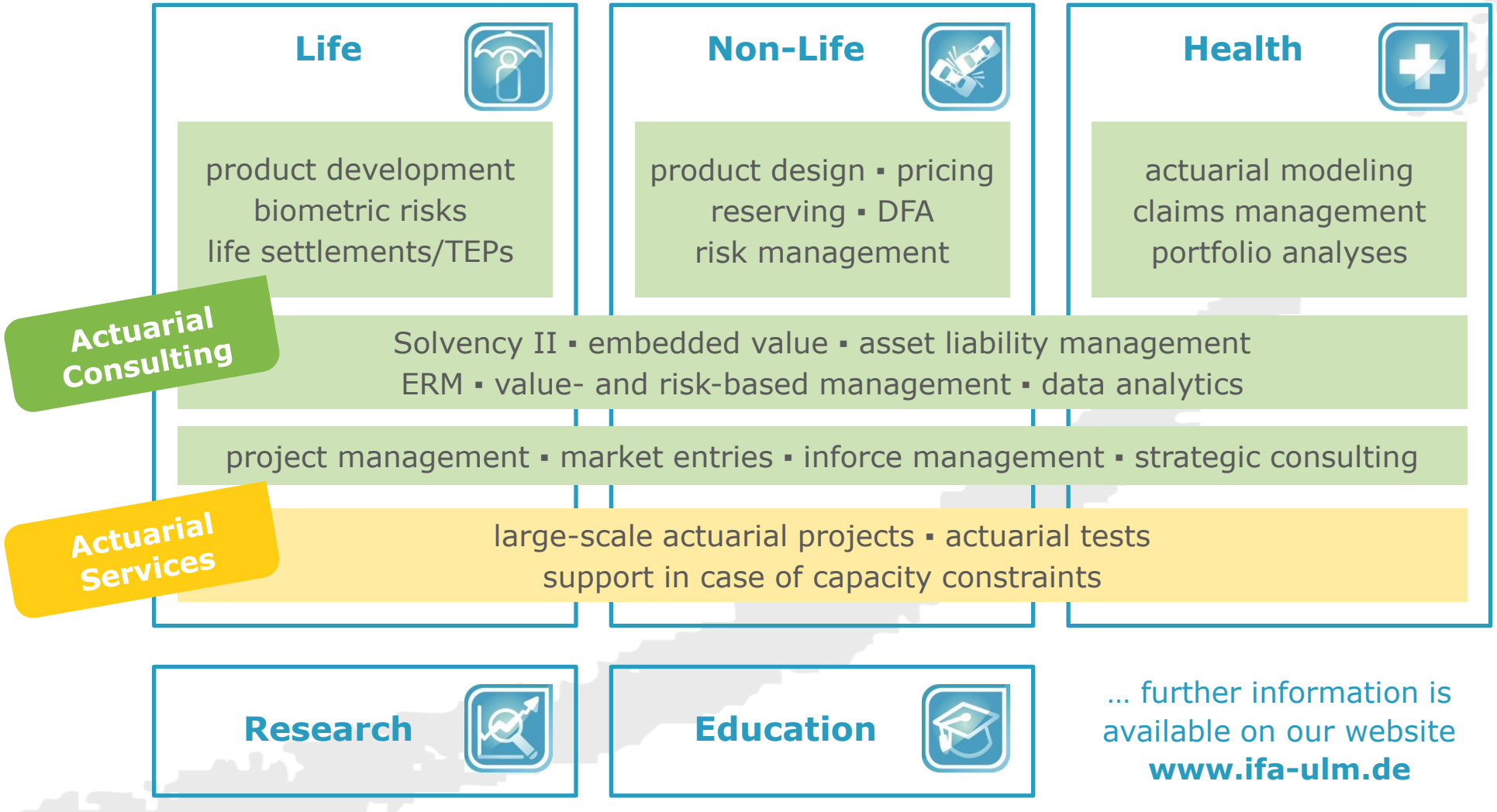

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