Multi-year Enterprise Risk Management based on Internal Models

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Overview

- Introduction: Increasing challenges on management strategy
- Model approach for measuring multi-year risk capital
- Development of multi-year risk capital
- Management strategies
- Conclusion and outlook
Increasing challenges on management strategy

- Negative developments on the capital markets
  - Resulting: completely altered risk situation for insurance industry

- Increase of natural catastrophes
  - Resulting: Increase of claims and reinsurance premiums

- This led to a substantial decrease in economic capital resources in insurance industry.

- Requirement for a higher level of transparency of the risk situation from management, regulators (Solvency II for European Union member countries), rating agencies, ...
Paradigm shift to modern management techniques such as **value and risk based management**.

- In this context a suitable structure in insurance portfolio together with an adequate asset allocation has become a major task for management. It is directed towards maximum return in relation to the risk taken for capital invested.

- This requires a strategic management which should follow a **multi-year view**.
Paradigm shift in insurance industry (2/2)

Classical Turnover Orientation

Return =

- Profit Premium-Ratio
- ...

Value and Risk Oriented

- Expected Economic Result
- Risk Capital
- Solvency II

- Return on Risk Adj. Capital (RoRAC)
- EVA (Economic Value Added) = Expected economic result beyond capital costs
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Internal models can be used as a base for strategic decisions in value and risk based management.

- Using an internal risk model the individual risk situation of the insurer can be modelled more exactly than using the standard formula from Solvency II, which is often not adequate (→QIS 5). Moreover the standard formula has only a one-year view and cannot create a **multi-year view**.

- If an insurer wants to use the internal model for solvency purposes, it has to be accepted by the national supervisor. So with our findings we want to give an idea of an internal model which can be accepted by the supervisor and which could pass the “use test”.
Random variable of economical results

Underwriting Risks
- Premium and Cat Risks (gross / net)
- Reserve Risks
- Investment Risks
- Operational Risks
- Enterprise Risks

+ Earned Premiums (gross)
- Ultimate Losses (gross)
- Costs
+/ - Reinsurance Result
+/ - Claims Development Result (Net)
= Net Insurance Result
+/ - Investment Result
- Result from Operational Risks
= Economic Result before Taxes

$P_t$
$U_t$
$C_t$
$N_t$
$DevRes_t$
$EcResLiab_t$
$EcResAs_t$
$O_t$
$EcRes_t$

modelled stochastically
For modeling the economic results we use different approaches:

- Statistical methods for modeling large and attritional claims of future accident years
- Results of meteorological models as a base for fitting distributions of catastrophe claims (earthquakes, storm, flood, hail)
- Stochastic reserving methods
- Re-reserving for modeling the one-year uncertainty
- Approaches for modeling dependency structures
- Simulation techniques
- etc.
Management rules and management strategies in multi-year models:
Different rules in different scenarios are needed

- Management rules: Increase of reinsurance premiums in simulations/scenarios with preceding years of high claim losses

- Management strategies in simulations with high claim losses, in order to improve results and to avoid negative excess capital. This can be the case for example after scenarios with natural catastrophes or with negative developments at the capital markets. Possible strategies could be:
  - Stop expansion in building
  - Introduction of deductibles in building (to limit the effect of storm events)
  - Higher reinsurance protection
  - Change in asset allocation (lower risk profile)
Defining multi-year risk capital helps management to answer the essential question in order to decide for the “best” strategy:

- How many years of catastrophe events or adverse capital market developments can the company withstand at a certain confidence level without needing external capital resources?

- How much risk capital the company will need to be able to survive the next five years – taking five future underwriting years into account – without external capital supply?
Defining multi-year results

Multi-year risk capital

Results (per simulation):
Incremental vs. cumulative

Risk capital

Results (per simulation):
Incremental vs. cumulative
Multi-year risk capital

Definition of multi-year risk capital

- Per simulation and per year $t$ we define cumulative losses

\[
\text{Cum. Loss } (1) = \text{Loss } (1) = -EcRes \ (1)
\]

\[
\text{Cum. Loss } (t) = \text{Cum. Loss } (t-1) + \text{Loss } (t), \ 1 \leq t \leq n.
\]

- We define the maximum over the years:

\[
\text{MaxLoss} = \max \{\text{Cum. Loss } (t)\}_{1 \leq t \leq n}
\]

- $\text{MaxLoss}$ represents the maximum of the amount that needs to be covered over the years for each simulation.

- The selected risk measure, $\rho$, can now be applied to the $\text{MaxLoss}: \Omega \rightarrow \text{IR}$ in order to determine the risk-capital requirement.
Definition of multi-year risk capital

- This amount needs to be provided at $t=0$ in the simulation path to allow the insurance company to cover all losses incurred over the entire period simulated ($n$ years) without external capital supply in this simulation path.
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Risk Capital (multi-year view)
In Million €

Example-Data from Simulation Study

We use TVaR 99.8% for quantifying one-year and multi-year risk capital.
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In practice management has to decide which strategy might improve the risk (and return) situation of a company if not enough (multi-year) risk capital is available: Lowering risk via change of the asset allocation, lowering risk via introduction of deductibles, extending reinsurance cover, or any suitable combination of these strategies. In this context the appropriate use of *diversification effects* plays an important role.
In the paper we studied the effects of different management strategies with regard to the realisation of the best of a given set of possible strategies for the risk and return situation of the company.

We analysed the effects of
- reinsurance structures,
- introduction of different amounts of deductibles,
- growth in special LoBs,
- change of asset allocation,
- different dependency structures,
- different capital allocation methods.
Return and risk situation as a base for value- and risk-based management

Management has to think about strategies so that risk capital requirement decreases (e.g. deductibles, reinsurance). If the insurance has enough economic capital to cover risk capital requirement, no change in strategy is necessary if the return position is adequate.

These lob create a negative return. Here management should think about strategies to improve the return situation.
We also analysed the effects of introduction of deductibles in storm, which leads to a significant reduction in risk capital.
The effects of strategies (example data)

Actual Strategy

New Strategy (after deductibles and reinsurance)
The effects of strategies (here: introduction of deductibles and reinsurance) can be shown in the percentile graph (reduction of risk, but also reduction of expected return).

**Simulated results (actual vs. new strategy)**

- **Actual Strategy**
- **New Strategy**

**Risk Capital**

<table>
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<th></th>
<th>Gross</th>
<th>Reinsurance</th>
<th>Net</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>291</td>
<td>201</td>
<td>90</td>
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The strategies and their impact need to be analysed at company level, where high diversification effects have a positive effect on total risk capital and economic value added (EVA).

In the example portfolio presented in the case study the introduction of deductibles in storm line of business led to growing diversification effects in insurance results (between storm and the other lines of business). The same holds for special types of reinsurance contracts. The effects of these strategies always depend on the portfolio structure.

Lowering multi-year risk capital and growing diversification effects offer the possibility of extending in lines of business where the return exceeds the capital costs and which show a high diversification towards the other lines of business in the portfolio.
Iterative management process

Management has to define:

I. Methods
II. Time horizon
III. Risk Tolerance
IV. Required return

1. Simulation of the actual strategy (results, risk capital) and comparison with management requirements
2. "Optimisation“ of liabilities (gross)
3. "Optimisation“ of reinsurance
4. "Optimisation“ of asset allocation
5. Simulation of the selected strategies for the company
6. Comparison to risk limit, management requirements, decision for a strategy or definition of new strategies if necessary

Iterative process (repetition with different strategies to find the “optimal“ strategy)
The iterative management process should consider the following restrictions:

- **Management requirements** concerning the results in the statutory balance sheets (intended investment or technical results, annual surplus, etc.)

- **Regulatory restrictions** (actually for European countries: Solvency I and analyses of worse scenarios; in the future: Solvency II)
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Conclusion and outlook

- With our multi-year model we can compare the effects of different management strategies. These results will influence various company processes such as risk limitation, development of insurance products, pricing, reinsurance, asset management, and marketing.

- In this context future product development will be oriented towards goals such as required risk capital and use of diversification potential. Instruments such as deductibles for policyholders in storm insurance aimed towards reducing risk capital requirement are gaining in importance. In this context adequate capital allocation methods are needed.
In addition to practitioners, regulators will also benefit from these results. Since the “use test” will play an important role for the approval of internal models, regulators will check if the internal model is used as a base for management decisions in enterprise risk management and in the ORSA process, whereby both should be based on a time horizon of several years.
Future Research

- Extend the simulation model in various directions
- Capital allocation in multi-year context
- Use the concept for strategic management on a group level
Thank you very much for your attention!
References


