The Actuarial Profession
making financial sense of the future

Munich RE

Risk management in life insurance
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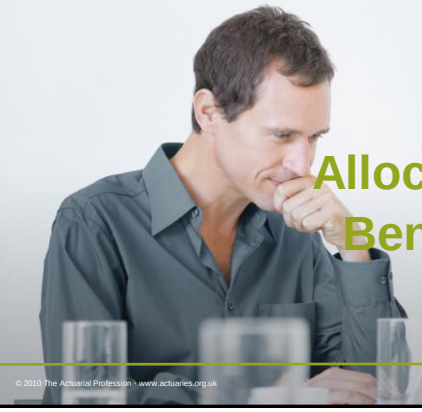


Allocating Diversification Benefits and Fungibility

23.03.2011

Agenda

1. Aggregation and diversification
2. Allocation: Theory and practice
3. Assessing capital fungibility: Two means to the same end (?)
4. Summary

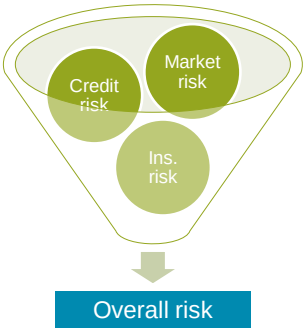
1. AGGREGATION AND DIVERSIFICATION

What is aggregation?

Concept

- An *aggregation method* is a method for determining the overall capital requirements on the basis of the stand-alone capital requirements of the underlying risk categories.
- The chosen aggregation method is the basis for the assessment of *diversification benefits*.
- Aggregation does not change the undertaking's exposure to the individual risk categories.
- Usually aggregation proceeds by specifying a *dependency structure* between the underlying risk categories. However, additional elements may be present as well (e.g. assumption on type of overall distribution).

Illustration



Choice of aggregation method is of pivotal importance.

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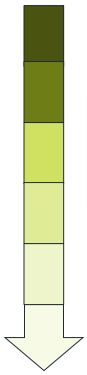
Data availability and reliability concerning dependencies ...

... within risk categories (illustration)

- Market risk
- Credit risk
- Basic loss risk
- Natural Cat risk
- Man-made Cat risk
- Life biometric risk



Data availability and reliability

... between risk categories

- Hardly any data available for most pairs
- Intuition suggests qualitative ranking (illustrative):

	Market	Credit	Nonlife	Life
Market				
Credit	High			
Nonlife	Medium	Medium		
Life	Low	Low	Low	

Any data-based analysis concerning dependencies must be complemented by certain assumptions, decisions and expert judgement.

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Two common ways of aggregation

	Aggregation of capital requirements	Aggregation of distributions
Process	• Determination of capital requirements for risk categories • Aggregation of stand alone capital requirements figures to arrive at overall capital requirement	• Determination of result distributions representing the different risk categories • Aggregation of distributions to arrive at overall result distribution
Prevalence	• Pure factor models like rating agency models • Standard regulatory models (Solvency II, SST)	• Internal models • Academic toy models
Advantages	• Conceptually easy • Computationally simple and fast	• Multiple dependency structures possible (copulas) • Better alignment with (risk) management / ALM, e.g. by allowing to assess the aggregate result at different return periods
Disadvantages	• Calibration challenging • Focus on one specific return period (usually "rare events") • Range of dependencies restricted – mostly simple correlation matrix • May give doubtful incentives for (risk) management, e.g. for ALM	• Calibration challenging • Conceptually more complex than correlation matrices • Possibly computationally time-consuming

Aggregation of distributions allows a larger range of options.

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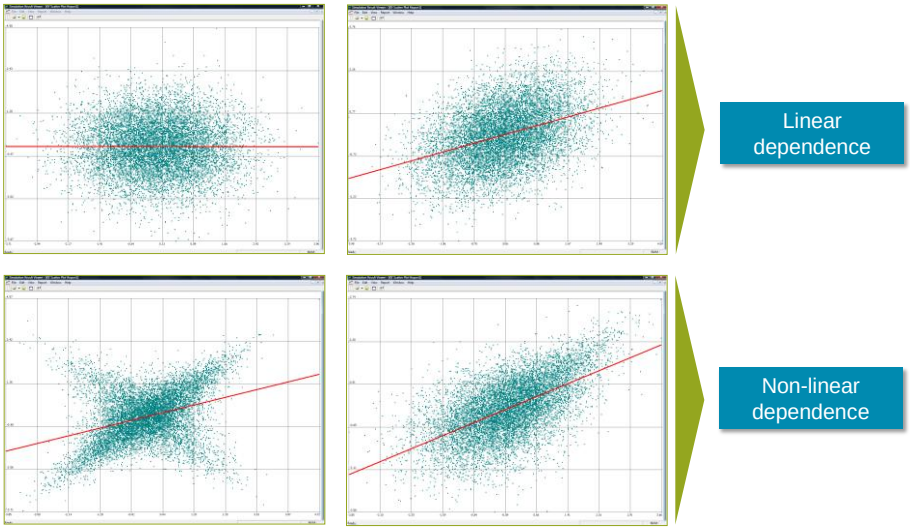
Choosing a dependency structure



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Calibrating dependencies between risk categories

- SCR and ERC represent tail scenarios.
- Thus, dependencies between risk categories should reflect tail events.
- At Munich Re we use specifically developed scenarios which incorporate cross-balance sheet events (e.g. a severe pandemic).
- With an assumption about dependencies in “normal circumstances” solve the following equation:

  «Scenario + normal dependency = Tail dependency»

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Aggregation: Upcoming challenges

Regulatory scepticism about diversification*:

- P. 4: “[T]he financial crisis that began in 2007 highlighted at least some degree of failure of risk aggregation methods.”
- P. 6: “Supervisors surveyed for this report understand that opportunities for diversification exist, but were skeptical that financial firms are able to measure diversification benefits reliably.”

High validation, documentation and communication efforts to be expected under Solvency II for internal model users.

*) Basel Committee on Banking Supervision – Joint Forum, *Developments in Modelling Risk Aggregation*, October 2010

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2. ALLOCATION: THEORY AND PRACTICE

Evolution of business steering

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Allocation principles investigated: Formulas

- Risk measure-proportional
  RBC_i := Risk measure[X_i] / $\sum_i$Risk measure[X_i]
- Covariance
  RBC_i := CoVar[X_i, X] / Var[X]
- Tail-VaR-Co-Measure
  RBC_i := E[X_i | X > Q_α(X)] / E[X | X > Q_α (X)]
- For n segments 1, ..., n let $S \subseteq N = \{1, ..., n\}$, s := |S|, c(S) := RBC(S) and $C_i := \{ S \in \wp(N) : i \in S \}$.
  The Shapley-value for segment i is defined as $\sum_{S \in Ci}$ (s-1)! (n-s)! / n! * [c(S) – c(S \ {i})]

Remarks on Shapley

1) c(S) – c(S \ {i}) = increment in RBC caused by segment i in coalition S
2) (s-1)! (n-s)! / n! = 1/n * (s-1)! (n-1-(s-1))! / (n-1)!
   = 1/[n * #{ $S \subseteq N$: |S| = s & $i \in S$ }]

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Aggregation and Allocation Principles

Theory

- Mathematical discussion on eligible properties based on *Denault (2001) et seq.*
  - Completeness: $\sum RC_k = RC = R(X)$
  - "No undercut": $\sum_{i \in M} RC_i \leq R(\sum_{i \in M} X_i)$
  - Symmetry:
    $R(\sum_{i \in M} X_i + X_m) = R(\sum_{i \in M} X_i + X_n)$
    $\Rightarrow RC_m = RC_n$
  - Riskless allocation: $RC(c) = c$ (or 0!)

- Interplay of allocation and risk measure
  - "No undercut" follows sub-additivity
  - Proportional methods on risk measure
  - Shapley allocation on various risk measures

Practice

Choice of allocation mechanism depends on mathematical and non-mathematical factors.

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Coherent allocation from a practical perspective

Properties of "coherent allocation" ...	... and their practical relevance
• Completeness	• Completeness is a crucial property. However, completeness should not be taken to imply ➢ a uniform return target (e.g. Life vs Nonlife) or ➢ a requirement of "value addition" by any business activity (e.g. growth usually has to be "financed" in the first years).
• No undercut • Symmetry	• No practical importance (complexity reasons, real-life constraints for business segments)
• Riskless allocation	• No relevance due to consideration of unexpected loss only. • Moreover, ERC is not suited to cover losses which are sure.

Theoretical requirements may not meet the "litmus tests" of reality!

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Tentative requirements concerning allocation from a steering perspective

Completeness

- The total amount of ERC has to be allocated.
- Value creating or destroying activities – deliberated or not – should be made explicit.

Stability

- *Ceteris paribus* local changes should be dominating changes from year to year.

Concentration

- Concentration risks should receive a "penalty" for exposing the undertaking.
- *Ceteris paribus* the higher the concentration the higher the ERC allocation.

Business adequacy

- The allocation principle should respect specifics of the business and the implied steering impulses.

Practical requirements concerning allocation cannot be reduced to pure mathematical properties.

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3. ASSESSING CAPITAL FUNGIBILITY: TWO MEANS TO THE SAME END (?)

Fungibility and Transferability within a Group

Fungibility

- Fungibility at group level means that an element of own funds can fully absorb any kind of losses within the group, regardless of the undertaking within which those own funds are held or where the commitments arise (in compliance with the local prudential and legal rules).
- Fungible capital in this sense is not dedicated to acertain purpose.

Group Own Funds

- The usability of local excess for the purpose of group solvency depends on restrictions within the corresponding unit.
- Those restrictions may be legal/regulatory or internal (e.g. Rating).

Transferability

- Transferability refers to the ability to transfer own funds from one undertaking to another within the group.
- Transferability leads to increase/decrease of own funds in a solo entity without increasing/decreasing the group own funds, except the likely cost of the transfer.

The determination of group solvency based on a consolidated balance sheet must incorporate fungibility and transferability restrictions.

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Non-available own funds and their impact of group OF

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Details of step 4 - current status (QIS5)

G.66. In addition to surplus funds and any subscribed but not paid-up capital, other own funds could also be considered as not effectively available to cover the SCR of the participating insurance undertaking for which the group solvency is calculated. Such non-available own funds may cover the group SCR only in so far as they are eligible to cover the SCR of the related undertaking.

G.67. The group should pay particular attention to own funds which are indicated in subsection G.2.6 below when assessing their availability at group level.

G.68. For each related undertaking, the global amount of solo non-available own funds should be considered available for covering the group SCR up to the contribution of solo SCR to group SCR.

G.69. In order to assess the contribution of solo SCR to group SCR from entity j ($Contr_j$) included in the calculation of SCR^* (the entities for which diversification is recognised), the following proxy should be used:

$$Contr_j = SCR_j \times \frac{SCR^*}{\sum_i SCR_i^{solo}}$$

where:

- the index (i) covers all entities of the group included in the calculation of the SCR^*
- SCR_i^{solo} is the solo SCR of entity i
- SCR_j is the SCR of undertaking j
- the ratio can be considered as a proportional adjustment due to diversification effects

G.74. For undertakings using an internal model the attribution of diversification can be carried out using the internal model. Groups should explain the method used for allocating diversification effects when using an internal model.

G.17. In order to assess group solvency, it is necessary to determine the amount of group own funds which are eligible to cover the group SCR. This assessment has to be made after the elimination of double use of eligible own funds among the different insurance or reinsurance undertakings taken into account in the calculation and for both calculation methods (default or deduction/aggregation).

G.18. The assessment needs, in particular, to consider the availability of the own funds of each entity within the scope of group solvency. This means that own funds that can not be made both fungible (i.e. absence of dedication to a certain purpose) and transferable (i.e. absence of significant obstacles to moving assets from one entity of the group to another) for the group within a maximum of 9 months can not be considered effectively available at group level.

Diversification and Capital Fungibility Constraints

A joint distribution of to legal entities X and Y
(positive values = losses)

2	4%	9%	21%
-1	11%	14%	9%
-4	19%	11%	4%
Y / X	-1	0	1

If capital is fully transferable between two legal entities X and Y then Y can transfer 1 to X in this case in order to avoid X's shortfall without running into problems itself. The compensation of losses of one risk X by profits from another risk Y is called *diversification benefit*.

In reality, there sometimes exist *capital fungibility constraints* (e.g. from regulatory requirements).

In the above example, the scenario X = 1 and Y = -4 might represent a shortfall of the ‚group' consisting of X and Y as Y might not be allowed to transfer capital to X.

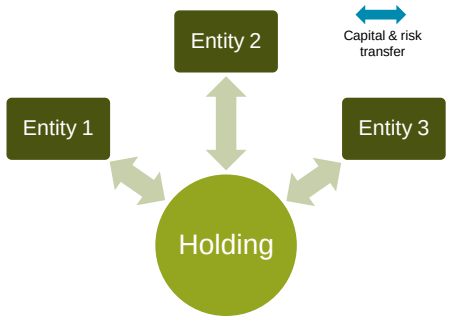
More economic risk capital is needed under capital fungibility constraints.

Representation of capital fungibility within the MRCM

Fungibility in the MRCM

- A simplified model of Munich Re's group structure is built and correlated results per entity are simulated.
- The fungible excess for each simulated result is transferred to the parent.
- In turn the parent balances losses up to the point of insolvency for each entity.
- As a result it is possible to derive the distribution of Munich Re taking restricted capital fungibility into account.

Illustration



The modelling of capital fungibility at Munich Re leads to an increase of ERC.

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Two means to the same end?

Adjusting Own Funds

- Avoids stochastic calculations
- Easier than ERC / SCR adjustment
- May lead to artefacts: Consider a group with 2 companies, each at 200% solvency ratio and 100% non-fungible capital ⇒group solvency ratio of 100%

Adjusting ERC / SCR

- Uses Own Fund adjustment as a starting point
- Conceptually more convincing
- Computationally more involved

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4. SUMMARY

Summary for actuaries

- Aggregation especially across risk categories has to be based on science and expert judgement. Regulators are sceptical about diversification and hence aggregation techniques used within internal models will be put under scrutiny during the supervisory review.
- Allocation of risk capital has to be aligned with various practical considerations which are specific to each company.
- Assessing capital fungibility is so far largely untested but may have an impact on future corporate structure.

A “one-size-fits-all” approach does not work!

Summary for poets

IT IS THE PERVADING LAW OF ALL THINGS ORGANIC AND INORGANIC,

OF ALL THINGS PHYSICAL AND METAPHYSICAL,

OF ALL THINGS HUMAN AND ALL THINGS SUPER-HUMAN,

OF ALL TRUE MANIFESTATIONS OF THE HEAD,

OF THE HEART, OF THE SOUL,

THAT THE LIFE IS RECOGNIZABLE IN ITS EXPRESSION,

THAT **FORM** EVER **FOLLOWS FUNCTION**. THIS IS THE LAW.

LOUIS SULLIVAN, THE TALL OFFICE BUILDING ARTISTICALLY CONSIDERED

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Risk management in life insurance
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Thank your very much for your attention!

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