Reinsurance

Fundamentals of risk management and reinsurance in practice

Peter Liebwein
Version 20.04.2014
2 LP (Diploma); 3 ECTS (Master of Science)
Summary

- An overview over RISK-MANAGEMENT in insurance companies will be presented. Here, REINSURANCE will be derived as one of the options to mitigate insurance risks.
- In context of reinsurance according proportional and non-proportional TYPES OF REINSURANCE TREATIES will be studied (inter alia); some typical PRICING APPROACHES will be analyzed for the respective types of treaties.
- Finally, there is an introduction into ALTERNATIVE RISK TRANSFER.
ORGANIZATIONAL ISSUES

Prob. density vs. Loss

0.1 Disclaimer and copyright

To avoid any misunderstandings:

- This lecture and these documents are based on the personal opinion of the trainer which in turn does not necessarily coincide with the opinion of any third party.

- This lecture and these documents are intellectual property of the author and are protected by copyright. Unapproved disclosure to third parties violates this copyright. If you want to pass these documents to third parties, please contact the author *in advance.*
0.2 Overview
0.2.1 Structure

Alternative risk transfer

Reinsurance programs

Proportional reinsurance

Nonproportional reinsurance

“Traditional” reinsurance

Fundamentals of risk management
0.2 Overview

0.2.2 Outline

1 Motivation

2 Risk management for insurers
   2.1 Basics and definitions
   2.2 Purpose and goals
   2.3 Classification of risk management
   2.4 Risk management core process
   2.5 Risk management service process
   2.6 Types of risk mitigation options

3 “Traditional” reinsurance
   3.1 Basics and definitions
   3.2 Purpose and goals
   3.3 Classification of types
   3.4 Techniques of proportional r/i
   3.5 Pricing proportional r/i
   3.6 Techniques of nonproportional r/i
   3.7 Pricing nonproportional r/i

4 Alternative risk transfer
   4.1 Basics and definitions
   4.2 Purpose and goals
   4.3 Classification of types
   4.4 Insurance linked bonds
   4.5 Further examples

Appendix
## 0.2 Overview

### 0.2.2 Schedule – 15+1 blocks (I)

<table>
<thead>
<tr>
<th>Day</th>
<th>Mon 28.04.</th>
<th>Wed 30.04.</th>
<th>Mon 05.05.</th>
<th>Thu 06.05.</th>
<th>Fri 07.05.</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00</td>
<td>Risk management process</td>
<td></td>
<td>R/I nonprop. techniques</td>
<td></td>
<td>ART</td>
</tr>
<tr>
<td>10:00</td>
<td>Introduction motivation</td>
<td>Risk mitigation option</td>
<td>Recap risk management</td>
<td>R/I nonprop. techniques</td>
<td>Discussion regarding exam</td>
</tr>
<tr>
<td>12:00</td>
<td>Risk management introduction</td>
<td></td>
<td>R/I introduction and goals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:00</td>
<td>Risk management process</td>
<td>Recap risk management</td>
<td>R/I proportional techniques</td>
<td>R/I nonprop. pricing</td>
<td></td>
</tr>
<tr>
<td>03:00</td>
<td>Risk management process</td>
<td>R/I introduction and goals</td>
<td></td>
<td></td>
<td>ART</td>
</tr>
<tr>
<td>05:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
0.2 Overview

0.2.2 Schedule – 13+1 blocks (II)

- Time (irrespective of schedule): To be defined.
- Rooms (scheduled*):

  Dates

  - April 26, 2014; 11 am - 7 pm (c.t.)
    BWV München e.V., Fritz-Erler-Straße 30, 81737 München, room E03/E04
  - April 30, 2014; 8 am - 5 pm (c.t.)
    BWV München e.V., Fritz-Erler-Straße 30, 81737 München, room E03/E04
  - May 5, 2014; 11 am - 7 pm (c.t.)
    BWV München e.V., Fritz-Erler-Straße 30, 81737 München, room 114
  - May 6, 2014; 8 am - 5 pm (c.t.)
    BWV München e.V., Fritz-Erler-Straße 30, 81737 München, room 114
  - May 7, 2014; 8 am - 1 pm (c.t.)
    BWV München e.V., Fritz-Erler-Straße 30, 81737 München, room 114

  Examination

  - To take the exam, registration via the LSF-Portal is necessary. Students that cannot register via this portal can send an e-mail to jaeger@bwl.lmu.de.
  - Deadline for exam registration: tbd
  - 1-hour written exam
  - 2 LP (Diploma)
  - 3 ECTS (Master)
  - Date: Monday, May 26, 16:30-17:30; Schellingstraße 3 Room 005 (LSF-Registration till May 19)

Ad *): As per 20.04.2014. For updates please see website:
http://www.inriver.bwl.uni-muenchen.de/studium/sommer_2014/masterveranstaltungen/reinsurance1/index.html
0.2 Overview
0.2.2 Schedule – 13+1 blocks (III)

- Rooms (scheduled*):

Ad *): https://maps.google.com/maps?q=Fritz-Erler-Stra%C3%9Fe+30,+Munich,+Germany&hl=en&ie=UTF8&ll=48.097811,11.647494&spn=0.000029,0.021136&sll=41.052063,-73.639351&sspn=0.29308,0.676346&hnear=Fritz-Erler-Stra%C3%9Fe+30,+Ramersdorf-Perlach+81737+M%C3%BCnchen,+Germany&t=m&z=16&layer=c&cbll=48.097811,11.647494&panoid=_82UIHjUWm9dhpt76MnFACbp=12.294.05,,0,0

0.3 Mandatory literature

0.3.1 Risk management


0.3 Mandatory literature
0.3.2 Reinsurance

- Swiss Re: Introduction into reinsurance, 7th edition, Zurich 2002 (English and German)
- Swiss Re: Securitization: New opportunities for insurers and investors, sigma 7/2006 (English and German)
0.4 Methodology
0.4.1 Learning goals

Get a deeper understanding of:

- Fundamentals of risk management
  - Notion of risk and risk management process
- Purpose, techniques, and price of “traditional” r/i
  - Proportional reinsurance
  - Non-proportional reinsurance
- Purpose and techniques of “modern” r/i
  - To some extent: Alternative risk transfer
0.4 Methodology
0.4.2 “Negative” specifications

Out of scope are:

- Aspects of risk theory and decision theory
  - See “Risk and Insurance”

- Managerial aspects of a r/i company
  - See standard business administrations

- Aspects of reinsurance accounting
  - See “general” accounting (e.g. Prof. Ballwieser)
  - See “insurance accounting “ (e.g. Rockel; Ott)
0.4 Methodology
0.4.3 Language issues

- “Broken English spoken perfectly.”
- This lecture is held in English by a non-native speaker to (usually) non-native speakers
- The reasons are two-fold
  - Most technical terms are in English anyway
  - Internationalization and globalization of human capital point at the pure necessity of knowing several foreign languages – in addition to technical competence
- In this lecture, our goal is to drop “shyness”, to allow for mistakes, and to unconsciously improve…
CHAPTER 1: Motivation

Alternative risk transfer

Reinsurance programs

Proportional reinsurance

Nonproportional reinsurance

“Traditional” reinsurance

Fundamentals of risk management
1.1 Some loss events
1.1.1 Examples (I)

History’s most costly natural catastrophe: A satellite picture of Hurricane Katrina, which caused losses of USD 80.4 billion in 2005.

History’s biggest man made catastrophe: The terrorism attacks on Sep-11-2001 caused a loss of USD 25.7 billion.

Losses in USD as indexed to 2013; source: sigma 1/2014, p. 43.
http://www.hurricanekatrina.com/images/hurricane-katrina-category-5.jpg
http://www.drjudywood.com/articles/why/whypics/18_wtc1heli.jpg
1.1 Some loss events
1.1.1 Examples (II)

Product liability

Developments of capital markets

"I'm in here...reallocating Dad's retirement account into junk bonds."
1.1 Some loss events
1.1.1 Examples (III)

Death

Life/health
1.1 Some loss events
1.1.1 Examples (IV)

Financial markets turmoil

... and our measures

http://blogperso.univ-rennes1.fr/arthur.charpentier/public/perso/finance.JPG

http://sahajapower.files.wordpress.com/2008/04/confidence1.jpg
1.1 Some loss events

1.1.2 Facts and figures (I)

- The 15 most expensive insured losses 1970-2013*

<table>
<thead>
<tr>
<th>Insured loss</th>
<th>Victims</th>
<th>Date (start)</th>
<th>Event</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>80373</td>
<td>1836</td>
<td>25.08.2005</td>
<td>Hurricane Katrina: storm surge, levee failure, damage to oil rigs</td>
<td>US, Gulf of Mexico, Bahamas, North Atlantic</td>
</tr>
<tr>
<td>37665</td>
<td>19135</td>
<td>11.03.2011</td>
<td>Earthquake (Mw 9.0) triggers tsunami; aftershocks</td>
<td>Japan</td>
</tr>
<tr>
<td>36890</td>
<td>237</td>
<td>24.10.2012</td>
<td>Hurricane Sandy: storm surge</td>
<td>US et al</td>
</tr>
<tr>
<td>27594</td>
<td>43</td>
<td>23.08.1992</td>
<td>Hurricane Andrew: floods</td>
<td>US, Bahamas</td>
</tr>
<tr>
<td>25664</td>
<td>2982</td>
<td>11.09.2001</td>
<td>Terror attack on WTC, Pentagon and other buildings</td>
<td>US</td>
</tr>
<tr>
<td>22857</td>
<td>61</td>
<td>17.01.1994</td>
<td>Northridge earthquake (M 6.6)</td>
<td>US</td>
</tr>
<tr>
<td>22751</td>
<td>136</td>
<td>06.09.2008</td>
<td>Hurricane Ike: floods, offshore damage</td>
<td>US, Caribbean: Gulf of Mexico et al</td>
</tr>
<tr>
<td>17218</td>
<td>181</td>
<td>02.09.2004</td>
<td>Hurricane Ivan: damage to oil rigs</td>
<td>US, Caribbean: Barbados et al</td>
</tr>
<tr>
<td>16519</td>
<td>124</td>
<td>27.07.2011</td>
<td>Floods caused by heavy monsoon rains</td>
<td>Thailand</td>
</tr>
<tr>
<td>16142</td>
<td>815</td>
<td>22.02.2011</td>
<td>Earthquake (Mw 6.3), aftershocks</td>
<td>New Zealand</td>
</tr>
<tr>
<td>15570</td>
<td>35</td>
<td>19.10.2005</td>
<td>Hurricane Wilma: floods</td>
<td>US, Mexico, Jamaica, Haiti et al</td>
</tr>
<tr>
<td>12510</td>
<td>34</td>
<td>20.09.2006</td>
<td>Hurricane Rita: floods, damage to oil rigs</td>
<td>US, Gulf of Mexico, Cuba</td>
</tr>
<tr>
<td>11594</td>
<td>123</td>
<td>15.07.2012</td>
<td>Drought in the Corn Belt</td>
<td>US</td>
</tr>
<tr>
<td>10313</td>
<td>24</td>
<td>11.08.2004</td>
<td>Hurricane Charley: floods</td>
<td>US, Cuba, Jamaica et al</td>
</tr>
<tr>
<td>10031</td>
<td>51</td>
<td>27.09.1991</td>
<td>Typhoon Mireille/No 19</td>
<td>Japan</td>
</tr>
</tbody>
</table>

- A single loss can trigger the default/ruin case

1.1 Some loss events
1.1.2 Facts and figures (II)

- Development of insured losses 1970-2013*

140 in USD bn, at 2013 prices


- Earthquake/tsunami
- Weather-related catastrophes
- Man-made disasters
- 10-year average total insured losses

1.1 Some loss events
1.1.3 Loss filtering

- Loss analyses requires understanding of several layers

- reinsured losses
- insured losses
- financial losses
- loss to economy
- reality ("perils" and "values")

- not: losses excluded by reinsurance
- not: losses not insured / "public/state"
- not: unemployment or e.g. morbidity
- not: loss to "moral" values
- e.g. Tsunami increase of values
1.2 Risk management stakeholders

- Insured as stakeholder
  - Competition leads to a market with buyers’ power
  - Supervision: Meet liabilities sustainable

- Owner as stakeholder (stock company or mutual)
  - Increasing the value of the firm
  - Minimizing the risk of negative results

- Government as stakeholder
  - Taxation issues
  - Supervision: Solvency
CHAPTER 2: Risk management for insurers

Alternative risk transfer

Reinsurance programs

Proportional reinsurance

Nonproportional reinsurance

“Traditional” reinsurance

Fundamentals of risk management
2.1 Basics and definitions
2.1.1 “Finality”

- Definition
  - Target: Statement of a wanted condition or state*
  - Target system: Targets and their relations
  - Target dimensions:
    - Target content
    - Target extent
    - Time dimension

- Example: At least (!)
  12% RoE for next year

Ad *): As a result of a decision.
2.1 Basics and definitions

2.1.2 Risk (I)

- Lack of information
  - Deficit of information
  - Here: Regarding (at least) one target dimension

- Definition of risk
  - Lack of information with respect to achieving targets (i.e. a potential deviation of targets)

- Examples
  - Is the target achieved or not, and if so when or to what extent?
2.1 Basics and definitions

2.1.2 Risk (II)

- Didactical counter examples
  - Lack of uncertainty
  - Lack of “relevancy” for target

- Key characteristics
  - Depending on target
  - Depending on individuals, e.g. due to perception
2.1 Basics and definitions
2.1.3 Risk cause/effect (risk map)

- Cause/effect relations of drivers and target variables

Ad*): Including implemented risk mitigation options.
2.2 Purpose and goals
2.2.1 Steering the risk position (I)

- Risk management – inter alia – has the task to *mitigate/change the “target distributions” and their parameters* by coordinated implementation of risk mitigation options

- Steering the risk position depends on e.g.:
  - Target deviations (“failures”) become less and less probable
  - Expected number of failures become less probable
  - Expected severity of deviations become smaller
  - Expected total target deviation become smaller
2.2 Purpose and goals
2.2.1 Steering the risk position (II)

- Target distributions quantify the presented notion of risk
  - “x-axis”: Target variable (and extent)
  - “y-axis”: Probability distribution to model uncertainty
- Target distributions
  - Number/frequency of target deviations
  - Severity of target deviations
  - Total target deviation
2.2 Purpose and goals
2.2.1 Steering the risk position (III)

- Simplified model for risk position

- Why could position 4 be beneficial?
2.2 Purpose and goals
2.2.1 Steering the risk position (IV)

- Another model for risk position (see section 3*):
  - "downside": uncertainty measure
  - "better": Same risk with higher return
  - "upside": return measure
  - "better": Same return with lower risk

Discuss: How to compare these two?

- Remember Markowitz…
2.2 Purpose and goals

2.2.2 Steering implemented options

- Risk management – inter alia – has the task to mitigate/change the “target distributions” and their parameters by coordinated implementation of risk mitigation options.

- Steering of the implemented options
  - Continuously and rolling forward
    - Plan risk mitigation options
      (see decision theory)
    - Implement risk mitigation options
    - Check effectiveness of risk mitigation options and their implementation
2.3 Classification
2.3.1 Degree of integration

- Partial risk management
  - Restrict to some driving variables
    (e.g. technical issues, jurisdiction (lobbying))
  - Restrict to some transformation areas
    (e.g. sales, investments)
  - Restrict to some targets
    (e.g. underwriting targets, corporate result)

- Total risk management (integrated, holistic,...)
  - All drivers, transformation areas, and targets
  - Respecting all inter-dependencies
2.3 Classification
2.3.2 Organization (I)

- Risk management system
  - Elements: Risk management positions/functions
  - Relations:
    - Between risk management positions/functions
    - Risk management process
    - Inter-dependencies to “remaining” organization
2.3 Classification

2.3.2 Organization (II)

- Set up
  - Distribution of jobs and powers (risk management positions)
  - Rights to order and to decide, degree of participation and centralization
  - Inter-dependency to “remaining” positions/functions

- Processes
  - Risk management process
  - Inter-dependency of risk management processes and “remaining” processes
2.3 Classification
2.3.3 Risk management sub-process

- Risk management process and sub processes

Risk management core process

- Risk management core process:*
  Target focused steering of the risk position

- Risk management service/supportive process:**
  Coordinating and steering of the core process

Ad *): “Primary” activities.
Ad **): “Secondary” / “supportive” activities.
2.4 Risk management core process

2.4.1 Identify

- Structure and identify transformation areas
  - e.g. underwriting / sales / investments / reinsurance

- Structure and identify driving factors
  - e.g. internal / external (natural/technical/…)

- Identify inter-dependencies
  - identify mutual relations (e.g. correlations)
  - identify cause/effect-relationships

- Outcome: (Almost) target independent cause/effect map
2.4 Risk management core process
2.4.2 Measure/quantify

- Measure/quantify driving factors
  - e.g. stochastic loss model or capital markets model
- Measure/quantify inter-dependencies
  - measure correlations and measure cause/effect-relationships
- Measure/quantify transformation areas
  - e.g. stochastic underwriting model or stochastic investment model
- Outcome: Measured/quantified target independent cause/effect map
2.4 Risk management core process
2.4.3 Evaluate*

- Connect sub-targets and transformation areas
  - Measure/quantify cause/effect-relations

- Evaluate (and filter) transformation areas
  - e.g. can underwriting cause deviation from targets?
  - focus on “most dangerous” transformation areas

- Evaluate (and filter) driving factors
  - e.g. can inflation cause deviation from targets?
  - focus on “most dangerous” driving factors

- Outcome: Measured risk** map (risk cause/effect map)

Ad *): Implicit prerequisite: Target system is identified and measured/quantified.
Ad **): Remember the notion of risk with its dependency on the targets (and possible deviations).
2.4 Risk management core process

2.4.4 Implement risk mitigation (I)

- Identify risk mitigation options
- Analyze risk mitigation options
- Evaluate risk mitigation options
- Select (mix of) risk mitigation options
- Implement (mix of) risk mitigation options

Outcome
  - Measured risk** map (risk cause/effect map) including implemented risk mitigation options
  - Ideal case: Risk position aligned with targets

\[\text{i.e. core process as before including risk mitigation options}\]
2.4 Risk management core process
2.4.4 Implement risk mitigation (II)

- Theoretical support: Decision theory
- Decision matrix*

<table>
<thead>
<tr>
<th></th>
<th>target $k_1$</th>
<th>target $k_2$</th>
<th>evaluation (risk preference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>option $a_1$</td>
<td>evaluated result $X_{11}=g(a_1;k_1)$</td>
<td>evaluated result $X_{12}=g(a_1;k_2)$</td>
<td>$\Phi(a_1)$</td>
</tr>
<tr>
<td>option $a_2$</td>
<td>evaluated result $X_{21}=g(a_2;k_1)$</td>
<td>evaluated result $X_{22}=g(a_2;k_2)$</td>
<td>$\Phi(a_2)$</td>
</tr>
</tbody>
</table>

Ad *): Occasionally the matrix is set up with only one target and more discrete conditions with their occurrence probability.
2.4 Risk management core process

2.4.4 Implement risk mitigation (III)

- Practical examples (see section 3*):
  - Return on risk adjusted capital:
    \[
    \frac{\text{expected result}}{\text{required risk capital}} > \text{hurdle rate}
    \]
  - Economic value added:
    \[
    \text{expected result before capital cost} - \text{capital cost} > 0
    \]

- In general: Risk preference and risk preference functional needs to be defined and understood

Ad *): Occasionally the matrix is set up with only one target and more discrete conditions with their occurrence probability.
2.5 Risk management service process

- Steering and coordinating the core process
  - Define of responsibilities
  - (Continuously) communicate and document
  - (Continuously) steer, control, and check core process

- Interaction points of service process
  - At all process steps of the core process
  - At all partial results of the core process (especially checks of the risk position and the risk mitigation options and their implementation)
2.6 Types of risk mitigation options
2.6.1 Risk avoidance

- Definition
  - Options which avoid the “materializing of a risk”
  - Deviation from targets are excluded ex ante
  - Total risk avoidance versus partial risk avoidance

- Examples regarding insurance risk
  - Restrictive underwriting policy
  - Principle based / case related risk selection
  - Underwriting related product design (e.g. nuclear exclusion clauses)
2.6 Types of risk mitigation options

2.6.2 Risk sharing and risk transfer

- Definition
  - Split risks and jointly take/accept risks
  - (Partially) Transfer the risk to other individuals

- Examples regarding insurance risk
  - Transfer to insured (e.g. deductibles or retentions)
  - Transfer to other insurance companies
    (e.g. co-insurance and reinsurance)
  - Transfer to capital markets (e.g. ART)
2.6 Types of risk mitigation options

2.6.3 Risk diversification

- Definition (risk diversification, risk compensation)
  - Compensate loss potentials with potential profitable counter potentials (also for other targets than profit)
  - Resulting diversification is ideally disjoint, respectively independent / uncorrelated

- Examples regarding insurance risk
  - Diversification with respect to insurance products, lines of business, client segments, sales channels, regions, ...
  - Example: Munich RE versus Swiss Re (group)
2.6 Types of risk mitigation options

2.6.4 Risk “equalization”

- Remark
  - In general: Risk “equalization” ⊆ risk compensation
  - Specific role in an insurance company

- Definition (Albrecht modified)
  - The aggregated risk premium increases only digressively with increasing number of insured entities or number of insurance periods (with unchanged safety probability)

- Examples regarding insurance risk
  - Equalization with large number and/or over time
2.6 Types of risk mitigation options

2.6.5 Risk reserve creation

- Definition
  - Pooling of safety elements with high liquidity, which are used (only) in case of target deviations
  - Financial versus non-financial risk reserves
  - External versus internal risk reserves
  - Individual versus collective/group risk reserves

- Examples regarding insurance risk
  - R/I as external financial risk reserve generator
  - Equity, hidden reserves, to some extent equalization provision (Germany, Austria,… in local GAAP)
2.6 Types of risk mitigation options

2.6.6 Target revision

- **Remark**
  - Risk: Lack of information regarding target achieving
  - Risk avoidance “negates” targets set

- **Definition**
  - Target dimensions unchanged, preferences “relax”
  - Additionally: Risk preference/appetite “relaxes”

- **Examples**
  - Reduce targeted level or timing level
  - Increase “risk appetite”
2.6 Types of risk mitigation options

2.6.7 Risk acceptance

- Definition
  - The risk position is accepted
  - No risk mitigation option shall be implemented
- "Do nothing"
- Examples
  - …
CHAPTER 3: “Traditional” reinsurance

Alternative risk transfer

- Reinsurance programs
  - Proportional reinsurance
  - Nonproportional reinsurance
  - “Traditional” reinsurance

Fundamentals of risk management
CHAPTER 3:
“Traditional” reinsurance

Alternative risk transfer

Reinsurance programs

Proportional reinsurance

Nonproportional reinsurance

“Traditional” reinsurance

Fundamentals of risk management
3.1 Basics and definitions

3.1.1 Definitions

- German Seehandelsrecht (§ 779 Abs. 1 HGB): R/I is the insurance of the risks/perils taken over by insurers.
- EU directive (Art. 2(1)a 2005/68/EC): Taking over risks which are transferred from a (re-) insurer.
- Mack: Partially replacing uncertain loss cost by fix cost.
- Economics: Production factor of an insurer which is – as a product component – built in into the product “insurance protection”
3.1 Basics and definitions
3.1.2 A single risk transfer (I)

- Insurer and reinsurer as demander and supplier:

  ![Diagram](image)

  - Insurer (Insurance company)
  - Reinsurer (Insurance company)
  - Insurer as demander
  - Reinsurer as supplier
  - Reinsured party (cedent)
  - Reinsuring party (cessionnaire)
  - R/I product
  - R/I protection
  - R/I cession
  - R/I risk transfer
  - Outgoing/outwards R/I
  - Incoming/inwards R/I

- R/I broker as intermediary party

Ad *): Latin origin is “cedere”. Some literature and practitioners denote “cedant” which is simply wrong.
3.1 Basics and definitions
3.1.2 A single risk transfer (II)

- Classifying risk transfer

- Insured
  - Co-insurance
  - Insurance pools
  - Retention
  - Reinsurance
  - Alternative risk transfer

- Insurer
  - Retention
  - Capital markets
3.1 Basics and definitions

3.1.2 A single risk transfer (III)

- Splitting r/i contracts:
  - One treaty is placed with several reinsurers
  - same as co-insurance between (primary) insurers

![Diagram showing risk splitting among insurers and reinsurers]
3.1 Basics and definitions
3.1.3 Network of risk transfers

Building up portfolios

global atomizing

“straight forward” transfer direction  additional transfer direction
3.1 Basics and definitions
3.1.4 Professional r/i companies (I)

- Ranking 2011/12 (written net premium in million US-$)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
<th>Net reinsurance premiums written</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Munich Reinsurance Co.</td>
<td>$36,050.1</td>
<td>Germany</td>
</tr>
<tr>
<td>2</td>
<td>Swiss Re Ltd.</td>
<td>25,344.0</td>
<td>Switzerland</td>
</tr>
<tr>
<td>3</td>
<td>Hanover Re Group</td>
<td>15,869.9</td>
<td>Germany</td>
</tr>
<tr>
<td>4</td>
<td>Lloyd’s of London</td>
<td>11,132.7</td>
<td>U.K.</td>
</tr>
<tr>
<td>5</td>
<td>Berkshire Hathaway Reinsurance Group</td>
<td>10,162.0</td>
<td>U.S.</td>
</tr>
<tr>
<td>6</td>
<td>Scor S.E.</td>
<td>9,391.7 (2)</td>
<td>France</td>
</tr>
<tr>
<td>7</td>
<td>PartnerRe Ltd.</td>
<td>4,572.9</td>
<td>Bermuda</td>
</tr>
<tr>
<td>8</td>
<td>Everest Re Group Ltd.</td>
<td>4,081.1</td>
<td>Bermuda</td>
</tr>
<tr>
<td>9</td>
<td>Transatlantic Holdings Inc.</td>
<td>3,986.1 (2)</td>
<td>U.S.</td>
</tr>
<tr>
<td>10</td>
<td>Korean Reinsurance Co.</td>
<td>3,358.2 (3)</td>
<td>South Korea</td>
</tr>
</tbody>
</table>

Source: http://www.iii.org/commerciallines/rankings/  Rankings for 2013 are not yet available.
3.1 Basics and definitions

3.1.4 Professional r/i companies (II)

- Market shares and their development

Table 41: Reinsurance market shares in terms of net written premiums

<table>
<thead>
<tr>
<th>Top 10 reinsurers market share %</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Munich Re</td>
<td>18.4%</td>
<td>17.4%</td>
<td>16.2%</td>
<td>19.2%</td>
<td>18.6%</td>
<td>17.4%</td>
<td>17.4%</td>
</tr>
<tr>
<td>Swiss Re</td>
<td>15.6%</td>
<td>17.0%</td>
<td>15.2%</td>
<td>16.7%</td>
<td>17.0%</td>
<td>14.6%</td>
<td>14.6%</td>
</tr>
<tr>
<td>Berkshire</td>
<td>7.5%</td>
<td>7.0%</td>
<td>7.2%</td>
<td>8.1%</td>
<td>10.7%</td>
<td>6.8%</td>
<td>6.8%</td>
</tr>
<tr>
<td>Hannover</td>
<td>5.5%</td>
<td>6.7%</td>
<td>6.6%</td>
<td>6.6%</td>
<td>6.5%</td>
<td>6.5%</td>
<td>7.3%</td>
</tr>
<tr>
<td>Lloyd’s</td>
<td>4.9%</td>
<td>4.2%</td>
<td>4.7%</td>
<td>5.9%</td>
<td>5.1%</td>
<td>5.7%</td>
<td>5.7%</td>
</tr>
<tr>
<td>SCOR</td>
<td>2.7%</td>
<td>2.2%</td>
<td>1.9%</td>
<td>3.4%</td>
<td>4.8%</td>
<td>5.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td>RGA</td>
<td>1.7%</td>
<td>2.2%</td>
<td>2.6%</td>
<td>3.0%</td>
<td>3.0%</td>
<td>3.3%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Transatlantic</td>
<td>2.1%</td>
<td>2.5%</td>
<td>2.8%</td>
<td>2.7%</td>
<td>2.4%</td>
<td>2.5%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Everest Re</td>
<td>2.1%</td>
<td>3.0%</td>
<td>2.8%</td>
<td>2.7%</td>
<td>2.4%</td>
<td>2.2%</td>
<td>2.2%</td>
</tr>
<tr>
<td>PartnerRe</td>
<td>2.3%</td>
<td>2.5%</td>
<td>2.6%</td>
<td>2.6%</td>
<td>2.3%</td>
<td>2.5%</td>
<td>3.7%</td>
</tr>
<tr>
<td>Top 40 Reinsurance industry total</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Top 10 market share relative to top 40</td>
<td>62.7%</td>
<td>64.5%</td>
<td>62.5%</td>
<td>70.8%</td>
<td>73.0%</td>
<td>66.5%</td>
<td>68.5%</td>
</tr>
<tr>
<td>Top 5 market share relative to top 40</td>
<td>51.9%</td>
<td>52.1%</td>
<td>49.9%</td>
<td>56.5%</td>
<td>58.0%</td>
<td>51.1%</td>
<td>51.8%</td>
</tr>
<tr>
<td>4 European reinsurers relative to top 40</td>
<td>42.1%</td>
<td>43.2%</td>
<td>39.9%</td>
<td>45.9%</td>
<td>47.0%</td>
<td>43.6%</td>
<td>44.4%</td>
</tr>
</tbody>
</table>


3.1 Basics and definitions
3.1.4 Professional r/i companies (III)

- For comparison purposes: Ranking 2012 of insurers

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
<th>Revenues</th>
<th>Country</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Japan Post Holdings</td>
<td>$190.9</td>
<td>Japan</td>
<td>Life/health</td>
</tr>
<tr>
<td>2</td>
<td>Berkshire Hathaway</td>
<td>162.5</td>
<td>U.S.</td>
<td>Property/casualty</td>
</tr>
<tr>
<td>3</td>
<td>AXA</td>
<td>154.6</td>
<td>France</td>
<td>Life/health</td>
</tr>
<tr>
<td>4</td>
<td>Allianz</td>
<td>130.8</td>
<td>Germany</td>
<td>Property/casualty</td>
</tr>
<tr>
<td>5</td>
<td>Assicurazioni Generali</td>
<td>113.8</td>
<td>Italy</td>
<td>Life/health</td>
</tr>
<tr>
<td>6</td>
<td>UnitedHealth Group</td>
<td>110.6</td>
<td>U.S.</td>
<td>Health</td>
</tr>
<tr>
<td>7</td>
<td>Prudential</td>
<td>87.9</td>
<td>U.K.</td>
<td>Life/health</td>
</tr>
<tr>
<td>8</td>
<td>Nippon Life</td>
<td>86.7</td>
<td>Japan</td>
<td>Life/health</td>
</tr>
<tr>
<td>9</td>
<td>Prudential Financial</td>
<td>84.8</td>
<td>U.S.</td>
<td>Life/health</td>
</tr>
<tr>
<td>10</td>
<td>Munich Re Group</td>
<td>84.0</td>
<td>Germany</td>
<td>Property/casualty</td>
</tr>
</tbody>
</table>

(1) Based on an analysis of companies in the Global Fortune 500. Includes stock and mutual companies.
(2) Revenues include premium and annuity income, investment income and capital gains or losses, but exclude excise taxes.

Source: http://www.iii.org/commerciallines/rankings/ Rankings for 2013 are not yet available.
3.2 Purpose and goals

3.2.1 Overview (I)

- Targets with taking reinsurance to support achieving all corporate targets

- R/I shows effects to the entire target system of the insurer

- Buying r/i is motivated by various targets
3.2 Purpose and goals
3.2.1 Overview (II)

- Classifying targets when taking reinsurance
3.2 Purpose and goals

3.2.2 Underwriting and safety

- Reduce and mitigate insurance risk
  - Transfer of insurance risk is most important target
  - Protection against large losses and catastrophes
- Support original tariff calculation (service)
  - Information about tariff variables is key
  - Reinsurer can provide information and support
- Increase underwriting capacity
  - Capital strength and know how are limited
  - R/I can take over peak risks and provide services
3.2 Purpose and goals

3.2.3 Financial statements (I)

- Stabilize performance of business
  - Randomness of total loss leads to fluctuations in results
  - Reinsurance (partially) replaces uncertain losses with fixed r/i cost
  - R/I stabilizes the underwriting result

- Protect elements derived
  - Protect returns, dividends, etc.
  - Protect key financial indicators (e.g. loss ratio)
3.2 Purpose and goals
3.2.3 Financial statements (II)

- Thought experiment: Where would you invest?
3.2 Purpose and goals
3.2.4 Further goals (I)

- Regulatory requirements
  - Should guarantee policyholder protection (insurer must meet their obligations)
  - Capital requirements depending on risk position
  - R/I is key regarding insurance risk; is always taken into account

- R/I replaces capital (requirement)
  - Approximation P&C: Equity / net premiums ≥ x% (see workshop and discussion!)
  - R/I reduces risks (net premiums) and thus capital requirements
3.2 Purpose and goals
3.2.4 Further goals (II)

- “Financial aspects”
  - Increased investment demand, e.g.
    - New entity, new line of business, new region
    - Acquisition cost (especially life insurance)
    - Growth periods (see solvency requirements)
    - Extraordinary loss development
  - R/I can support significantly
  - Note: Requirements regarding minimal transfer of insurance risks have to be met
3.2 Purpose and goals
3.2.4 Further goals (III)

- “Equalizing aspects”
  - International accounting standards (IAS/IFRS, US GAAP) do not feature equalization provisions
  - R/I is one of the remaining possibilities to smooth results (equalization in time)
  - Note: Requirements regarding appropriate disclosure in financial statements have to be met

- Further perspectives
  - Rating and financial analysts
  - Risk management and capital cost
3.2 Purpose and goals

3.2.4 Reinsurance services

- Some examples: Consulting and supporting of
  - Actuarial tasks
  - Assessment and underwriting of special risks
  - Loss research, loss prevention, loss handling
  - Information regarding new markets / products
  - Training of cedent’s employees
  - Aspects not related underwriting (e.g. investments)

- Reinsurers can go much further than “just” providing capacity (where to be is a strategic positioning)
3.2 Purpose and goals
3.2.5 Empirical field studies (I)

- Answers from 1 (not at all) to 5 (very much) for the goal weights (multiple choices allowed)

<table>
<thead>
<tr>
<th>Analyzed goals</th>
<th>1979</th>
<th>1979</th>
<th>1991</th>
<th>1991</th>
<th>trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce insurance risk</td>
<td>4,22</td>
<td>1,19</td>
<td>4,62</td>
<td>0,48</td>
<td>+</td>
</tr>
<tr>
<td>Take over periodic extra losses</td>
<td>3,2</td>
<td>1,49</td>
<td>3,73</td>
<td>1,24</td>
<td>+</td>
</tr>
<tr>
<td>Increase underwriting capacity</td>
<td>3,58</td>
<td>1,41</td>
<td>3,51</td>
<td>1,13</td>
<td>-</td>
</tr>
<tr>
<td>Achieve a positive underwriting result</td>
<td>3,4</td>
<td>1,2</td>
<td>3,49</td>
<td>1,13</td>
<td>+</td>
</tr>
<tr>
<td>Transfer expected losses (negative results)</td>
<td>2,89</td>
<td>1,05</td>
<td>3,38</td>
<td>1,15</td>
<td>+</td>
</tr>
<tr>
<td>Maintain personal and technical relationships</td>
<td>3,31</td>
<td>1,26</td>
<td>3,19</td>
<td>1,09</td>
<td>-</td>
</tr>
<tr>
<td>Use services of reinsurer</td>
<td>2,36</td>
<td>1,09</td>
<td>3,16</td>
<td>1,08</td>
<td>+</td>
</tr>
<tr>
<td>Reduce net expenses</td>
<td>3,09</td>
<td>1,35</td>
<td>2,92</td>
<td>1,22</td>
<td>-</td>
</tr>
<tr>
<td>Increase ratio ‘equity / net premium’</td>
<td>2,62</td>
<td>1,21</td>
<td>2,89</td>
<td>0,98</td>
<td>+</td>
</tr>
<tr>
<td>Meet solvency requirements</td>
<td>2,09</td>
<td>1,16</td>
<td>2,62</td>
<td>1,15</td>
<td>+</td>
</tr>
<tr>
<td>Meet insurance group goals</td>
<td>2,4</td>
<td>1,41</td>
<td>2,51</td>
<td>1,15</td>
<td>+</td>
</tr>
<tr>
<td>Avoid liquidity shortfalls</td>
<td>2,09</td>
<td>1,13</td>
<td>2,46</td>
<td>1</td>
<td>+</td>
</tr>
<tr>
<td>Get reciprocity business</td>
<td>2,26</td>
<td>1,36</td>
<td>1,54</td>
<td>0,98</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,54</td>
<td>3,07</td>
<td></td>
<td></td>
<td>++</td>
</tr>
</tbody>
</table>

- More modern: Management of earnings volatility (risk management)
3.2 Purpose and goals
3.2.5 Empirical field studies (II)

- German non-life premiums in million EUR

<table>
<thead>
<tr>
<th>Company</th>
<th>Gross premium</th>
<th>Net premium</th>
<th>Ceded ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDI Gerling Industrie (Talanx)</td>
<td>2,819</td>
<td>1,067</td>
<td>62.1%</td>
</tr>
<tr>
<td>Allianz Global (Allianz)</td>
<td>2,191</td>
<td>1,224</td>
<td>44.1%</td>
</tr>
<tr>
<td>Zurich</td>
<td>2,283</td>
<td>1,350</td>
<td>40.9%</td>
</tr>
<tr>
<td>AXA</td>
<td>2,722</td>
<td>1,884</td>
<td>30.8%</td>
</tr>
<tr>
<td>Allianz</td>
<td>9,337</td>
<td>7,148</td>
<td>23.4%</td>
</tr>
<tr>
<td>Sector average</td>
<td>62,128</td>
<td>47,981</td>
<td>22.8%</td>
</tr>
<tr>
<td>Aachenmuenchener (Generali)</td>
<td>1,060</td>
<td>846</td>
<td>20.2%</td>
</tr>
<tr>
<td>Generali</td>
<td>966</td>
<td>791</td>
<td>18.1%</td>
</tr>
<tr>
<td>Victoria (Munich Re)</td>
<td>1,540</td>
<td>1,268</td>
<td>17.7%</td>
</tr>
<tr>
<td>Volksfuersorge (Generali)</td>
<td>706</td>
<td>592</td>
<td>16.1%</td>
</tr>
<tr>
<td>HDI-Gerling (Talanx)</td>
<td>806</td>
<td>681</td>
<td>15.5%</td>
</tr>
<tr>
<td>HDI Direkt (Talanx)</td>
<td>592</td>
<td>502</td>
<td>15.2%</td>
</tr>
<tr>
<td>Basler Seguritas</td>
<td>465</td>
<td>428</td>
<td>8.0%</td>
</tr>
<tr>
<td>Hamb Mannheimer (Munich)</td>
<td>740</td>
<td>682</td>
<td>7.8%</td>
</tr>
<tr>
<td>HUK Coburg</td>
<td>1,111</td>
<td>1,049</td>
<td>5.6%</td>
</tr>
<tr>
<td>DT. Ring Sachvers</td>
<td>137</td>
<td>130</td>
<td>5.1%</td>
</tr>
<tr>
<td>HUK Coburg</td>
<td>1,340</td>
<td>1,276</td>
<td>4.8%</td>
</tr>
<tr>
<td>DBV Winterthur (Axa)</td>
<td>536</td>
<td>513</td>
<td>4.3%</td>
</tr>
<tr>
<td>R+V</td>
<td>2,421</td>
<td>2,362</td>
<td>2.4%</td>
</tr>
</tbody>
</table>

3.3 Classification of types
3.3.1 Types like “original” (I)

- Cause/effect model of losses / deviations (risk map)

Ad*): Including implemented risk mitigation options.
3.3 Classification of types

3.3.1 Types like “original” (II)

- Insured peril, e.g.
  - Earthquake, flood, storm, hail, fire, ...

- Insured object or subject or insured interest, e.g.
  - Building contents, industrial business, life, death, ...
  - Liability, legal protection, ...

- Insured loss / insured compensation, e.g.
  - Compensating of losses (financial; also: “natural”)
  - Compensating defined sums
3.3 Classification of types
3.3.2 Type of agreements (I)

- Individual insured entities
- Collectives/groups of insureds
3.3 Classification of types
3.3.2 Type of agreements (II)

- Obligatory reinsurance (“treaty” reinsurance)
  - Reference to total underwriting collectives
  - Mandatory cession of insurer and mandatory acceptance of reinsurer

- Facultative reinsurance
  - Reference to individual single insured entities
  - Free decision of insurer to cede and free decision of reinsurer to accept

- Combinations (facultative/obligatory r/i)
### 3.3 Classification of types

#### 3.3.3 “Technical” types (I)

- Proportional r/i
  - R individual loss (also: Premium) of a insured entity
  - Split of R into:
    - \((1-c) \cdot R\) for account of insurer
    - \(c \cdot R\) for account of the reinsurer
  - The split of obligations is key under proportional r/i
3.3 Classification of types
3.3.3 “Technical” types (II)

- Nonproportional r/i
  - X large loss, event loss, annual total loss
  - Split of X into:
    - \( \min(X; a) \) for account of the insurer
    - \( \max(X - a; 0) \) for account of the reinsurer
  - The split of losses for defined losses is key under nonproportional r/i

- Combinations: In principle, proportional r/i is applied before nonproportional r/i
Blank slide
CHAPTER 3: “Traditional” reinsurance

Alternative risk transfer

Reinsurance programs

Proportional reinsurance  Nonproportional reinsurance

“Traditional” reinsurance

Fundamentals of risk management
3.4 Techniques proportional r/i

3.4.1 Characteristics (I)

- Risk transfer per insured entity
- Risk transfer by split in a certain relation (proportion)
- Obligation of an insured entity is spilt according to sum insured (or PML*) between insurer and reinsurer
- This split of obligations (“cession rate”) determines the entire handling of proportional reinsurance:
  - Split of premiums
  - Split of partial and total losses

Ad *): PML abbreviates Possible or Probable Maximum Loss. For sake of simplicity, the following paragraphs focus on sum insured.
3.4 Techniques proportional r/i
3.4.1 Characteristics (II)

- Two basic techniques
  - quota share
  - surplus reinsurance
  - combination (both ways)

- Ultimate target of the technique is to determine the split of obligations per insured entity
3.4 Techniques proportional r/i
3.4.2 Quota share (I)

- In principle, r/i participates at all insured entities with a fixed rate ("quota share"), the "cession rate"

- Retention of insurer is a percent of the sum insured

![Diagram showing quota share and portfolio after quota share]
3.4 Techniques proportional r/i
3.4.2 Quota share (II)

- Simple administration
- Reducing obligations in absolute terms
- Protecting against changes or errors regarding loss distributions
- Participating at relative stable small and medium sized business
- Contingent protecting against random risk effects
- No equalizing the retained portfolio in terms of sum insured
- In principle, no table of retentions possible
3.4 Techniques proportional r/i

3.4.3 Surplus (I)

- Reinsurer participates at insured entities which obligation exceeds the retention ("line") of the insured
- R/I obligation is defined by a *number* of lines

![Diagram showing portfolio and portfolio after surplus with insured sums and r/i contributions.](image)
3.4 Techniques proportional r/i
3.4.3 Surplus (II)

- Increasing underwriting capacity
- Equalizing retained portfolio in terms of sum insured
- Potentially protecting against large losses [rationale!]
- Additional table of retentions is possible
- Only contingent protecting against changes in “retail business”
- Only contingent protecting against accumulation
- More complex administration relative to quota share
- R/I results subject to (significant) higher fluctuations
3.4 Techniques proportional r/i
3.4.3 Surplus (III)

- “Layering” of surplus treaties

- Agreements (e.g. commission) per layer possible

- Only a few insured entities endow higher layers
  (additionally: Observations on premium level)
3.4 Techniques proportional r/i
3.4.4 Combination (I)

- Combination with surplus first ("gross surplus")

- Application e.g. subsidizing quota share
3.4 Techniques proportional r/i
3.4.4 Combination (II)

- Combination with quota share first ("gross quota share")

- Application e.g. “forced quota share” in regulated countries

3.5 Pricing proportional r/i
3.5.1 Excursion: Pricing/costing (I)

- Have a guess about producer’s cost and market price…

Apple’s i-pad

http://i.com.com/cnwk.1d/i/tim/2011/10/18/ipad-mini-300x300.jpg
3.5 Pricing proportional r/i

3.5.1 Excursion: Pricing/costing (II)

- Have a guess about producer’s cost and market price…

Nescafe’s Nespresso (machine and pads)

http://www1.nespresso.com/precom/goodies/wallpapers/nespresso12801024.jpg
http://www.coolhunting.com/images/Nespresso%20Romeo%20-%201.jpg
3.5 Pricing proportional reinsurance

3.5.1 Excursion: Pricing/costing (III)

- What would you be prepared to pay for...

![almost new vessel](http://www.freefoto.com/images/9906/09/9906_09_7---Tanker-vessel_web.jpg)
3.5 Pricing proportional r/i
3.5.1 Excursion: Pricing/costing (IV)

- In theory:
  - Result from costing: We know what reinsurer’s costs are to “produce” this certain r/i product.
  - The price for this product is what the reinsurer and the insurer agree upon. The determinants are e.g.:
    - Market context: A “function” of demand/supply for r/i capacity and transferred (insurance) risks.
    - Individual cost versus benefit: Insurer’s “balance” of the product’s cost (for the insurer the price is the cost) and the product’s benefits.

- In practice: Costing/pricing is mingled and called pricing
### 3.5 Pricing proportional r/i
#### 3.5.2 Part of original premium

- **Participating of r/i**
  - Proportional split of original premium
  - Split according to split of obligations (proportional r/i)
  - Key component of r/i price

- **As if system**
  - Premium which insurer is entitled to get
  - No transfer of operational risks

![Diagram showing the distribution of expenses, funding part, fluctuation, net risk, and net risk according to prop. split between insurer and reinsurer]
3.5 Pricing proportional r/i
3.5.3 Reinsurance commission (I)

- Compensation from r/i to insurer
- Expressed in percent r/i premiums
- Different rationales
  - Expense structure ("re-funding expenses")
  - Sales argument ("only“ price steering component for r/i)
  - Risk theory ("fair split")
  - Price calculation of r/i
3.5 Pricing proportional r/i
3.5.3 Reinsurance commission (II)

- Simplified* result of reinsurer:
  - + r/i premium ("follow the actions")
  - – r/i losses ("follow the fortunes")
  - – expenses of reinsurer (production factor human capital)
  - – capital cost of reinsurer (production factor capital)
  - – r/i commission (remainder)

- R/I commission to steer the r/i result

- Idea:
  - Good r/i business → high commission
  - Volatile r/i business → low commission

Ad *): Without further price components and without anticipated investment income.
3.5 Pricing proportional r/i
3.5.3 Reinsurance commission (III)

- Fix commission
  - Fix height of r/i commission rate
  - Simplicity versus in-flexibility
  - Loss development without direct price impact

- Sliding commission (rare)
  - Attaching commission to r/i result development
  - Attaching to loss ratio (or combined ratio)
  - Advantage for insurer and reinsurer (e.g. moral hazard and bridging loss perception gaps)
3.5 Pricing proportional r/i
3.5.4 Further price components

- Profit commission
  - Additional ex-post compensation by reinsurer
  - Prerequisites: Agreement and “r/i profit”
  - Advantage for insurer and reinsurer (e.g. moral hazard and bridging loss perception gaps)

- Loss participation
  - Additional ex-post price component by insurer
  - Prerequisites: Agreement and loss ratio (or combined ratio) above a certain threshold
CHAPTER 3:
“Traditional” reinsurance

Alternative risk transfer

Reinsurance programs

Proportional reinsurance
Nonproportional reinsurance

“Traditional” reinsurance

Fundamentals of risk management
3.6 Techniques nonproportional r/i
3.6.1 Characteristics (I)

- It’s reasonable to view the portfolio as a “loss generator” and to forget which individual insured entity produced the losses. (translated from Mack)
- No ceding of proportional obligations regarding insured entities
- Splitting and transferring of certain losses compensations of the insurer
- Limiting of r/i coverage per loss, per event, per year
3.6 Techniques nonproportional r/i
3.6.1 Characteristics (II)

- “Three” basic techniques of nonproportional r/i
  - per risk excess of loss
  - per event excess of loss
  - stop loss
  - Combinations (usually “prop before NP” and NP like denoted)
- Ultimate target of the technique is to determine the split of the losses in scope between insurer and reinsurer
3.6 Techniques nonproportional r/i
3.6.1 Characteristics (III)

- Theoretical “labeling”

<table>
<thead>
<tr>
<th>loss definition</th>
<th>occurrence probability or height of deductible</th>
</tr>
</thead>
<tbody>
<tr>
<td>working XL</td>
<td>cat XL</td>
</tr>
<tr>
<td>per risk</td>
<td>per event</td>
</tr>
<tr>
<td>excess of loss</td>
<td>excess of loss</td>
</tr>
<tr>
<td></td>
<td>stop loss</td>
</tr>
</tbody>
</table>

- “Labeling” in practice
3.6 Techniques nonproportional r/i
3.6.1 Characteristics (IV)

- Splitting the losses always follows the same principle
  - R/I is liable for loss exceeding a certain “deductible”
  - R/I is liable at a max for the maximum “loss cover”

- Expressing the nonproportional technique
  - R/I loss cover “in excess of” deductible
  - R/I cover “in excess of” deductible
  - R/I cover “xs” deductible
  - Example: 1.000.000 xs 500.000
### 3.6 Techniques nonproportional r/i

#### 3.6.2 Per risk excess of loss (I)

- Definition of loss: Single (large) loss
- Applies to single losses per insured entity (“per risk”)
- R/I cover limits:
  - per single loss (capacity)
  - maybe per year
  - maybe per event

![Diagram](image.png)
3.6 Techniques nonproportional r/i
3.6.2 Per risk excess of loss (II)

- Reducing the large loss burden
- Retaining small and medium sized losses
- Equalizing out loss burden in retention
- R/I result displays significant higher fluctuations
- Only contingent protecting against accumulations
- If loss distributions change, only contingent protection (in case above deductible, in this case reinsurer is liable to full extent up to his cover limit)
3.6 Techniques nonproportional r/i
3.6.2 Per risk excess of loss (III)

- “Time-wise and severity-wise” layering of XLs*

- Lower layers: Working XLs; upper layers: Cat XLs

Ad *): Per risk XLs and per event XLs; stop loss only severity layerings.
3.6 Techniques nonproportional reinsurance

3.6.3 Per event excess of loss (I)

- Definition of loss: Event loss or accumulation loss
- Applies in case of loss events affecting more insured entities at the same time (accumulation)
- Definition of an event is key!
- R/I cover limits:
  - per event (trivial)
  - maybe per year

Price versus cover:
"The lack of cover when the ultimate happens may ruin you; the higher deductible is unlikely to do so." (Kiln p. 196)

3.6 Techniques nonproportional r/i
3.6.3 Per event excess of loss (II)

- Definition of events
  - Any definition is possible
    (as long as it tries to be sufficiently clear)

- Three main criteria
  - “Logics” / reason / cause
  - Spatial dimension
  - Time dimension
3.6 Techniques nonproportional r/i
3.6.3 Per event excess of loss (III)

- Effectively protecting against accumulation or events
- Protecting over more lines of business possible
- R/I result displays significant higher fluctuations; therefore it is important
  - to equalize over time
  - to diversify e.g. over regions
- Only contingent protecting against changes in loss distributions
- Determining the exposure, appropriate deductible and capacity is not trivial
3.6 Techniques nonproportional r/i

3.6.4 Stop loss (I)

- Definition of loss: Relative (annual) total loss
- Expressing deductible and cover in relative terms; relative to business volume*
- Deductible to be exceeded in negative result cases
- Optimal? (Rationale in literature is “questionable” in some points)

Ad *): Usually earned premium net of all inuring reinsurance.
3.6 Techniques nonproportional r/i
3.6.4 Stop loss (II)

- Protecting against the total range of insurance risk (if effects are exceeding the deductible)
- Deductible could potentially be exceeded also in case of
  - Withdrawing/changing inuring r/i
  - Deteriorating premium levels in original tariffs
- Limiting moral hazard, e.g.
  - Applying for flood, hail, storm etc. only
  - Combining with other r/i covers
  - Introducing loss participations
3.7 Pricing nonproportional r/i
3.7.1 Similarities to insurance pricing

Original premium

- loading for expense and profit
  - [life and health: funding premium (dependent on time)]
  - fluctuation loading
  - safety loading
  - capital cost

- net risk premium (expected losses)

r/i premium (rate)

- Loadings
  - loading “rate”
- net risk premium rate
  - relative expected loss
- Total: (gross) premium rate,
  - so called “rate”
  - (relative to protected premium volume)
3.7 Pricing nonproportional r/i
3.7.2 Rating approaches (I)

- Calculating the expected loss of a r/i layer
  - Burning cost: Based on loss experience
  - Extrapolation: Based on distribution assumption also
  - “Pure” model: Based almost only on assumptions
  - Exposure rating: Based on split of portfolio
  - Pay back: Based on loss frequency (return periods)

- Calculating the expected loss is called “rating”
3.7  Pricing nonproportional r/i
3.7.2  Rating approaches (II)

- Expected loss depends on business volume ("size of the protected portfolio")
- Measuring usually with protected premium volume

- Relative expected loss = \( \frac{\text{expected loss to layer}}{\text{protected premium volume}} \) ("burning cost / risk rate")

- Protected premium volume: Usually earned premium income after deduction of all inuring r/i, especially proportional r/i
3.7 Pricing nonproportional r/i
3.7.3 Burning cost rating

- Example: Burning cost rating for per risk XL 100.000 xs 50.000

<table>
<thead>
<tr>
<th>year</th>
<th>net premiums</th>
<th>net losses</th>
<th>loss to layer</th>
<th>total</th>
<th>burning cost</th>
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</thead>
<tbody>
<tr>
<td>01</td>
<td>1.000.000</td>
<td>30.000</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>80.000</td>
<td>30.000</td>
<td></td>
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<tr>
<td></td>
<td>100.000</td>
<td>50.000</td>
<td>80.000</td>
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<td>8%</td>
</tr>
<tr>
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<td>1.000.000</td>
<td>40.000</td>
<td>0</td>
<td></td>
<td></td>
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<tr>
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<td>200.000</td>
<td>100.000</td>
<td>100.000</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>03</td>
<td>1.000.000</td>
<td>60.000</td>
<td>10.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60.000</td>
<td>10.000</td>
<td>20.000</td>
<td></td>
<td>2%</td>
</tr>
<tr>
<td>04</td>
<td>1.000.000</td>
<td>110.000</td>
<td>60.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>130.000</td>
<td>80.000</td>
<td>140.000</td>
<td></td>
<td>14%</td>
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<tr>
<td>05</td>
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<td>60.000</td>
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</tr>
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<td>660.000</td>
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<td>11%</td>
</tr>
</tbody>
</table>
3.7 Pricing nonproportional r/i
3.7.4 Extrapolation rating

- Loss experience is one of the starting points, and
- Assumption regarding loss distribution to extrapolate
3.7 Pricing nonproportional r/i
3.7.5 Model based rating

- Assumption or partial models* for loss frequency and loss severity distributions

Ad *): Model based rating is applied often for natural catastrophe covers. The according partial models are empirically validated in many cases.
3.7 Pricing nonproportional r/i
3.7.6 Exposure rating (I)

- Based on the characteristics (i.e. split) of the portfolio
- Split of the (risk adjusted) net risk premium:
  ind I (30.000), ind II (20.000), comm I (25.000), ...

Estimating the expected loss to layer:
- Ind I: 30% of 30.000
- Ind II: 10% of 20.000
- Comm I: 10% of 25.000
- Total: 13.500

Relative expected loss
- Relative to protected premium volume ("as always")
3.7 Pricing nonproportional r/i
3.7.6 Exposure rating (II)

- Background: Exposure curves

Source: Swiss Re (editor) Exposure rating, Zurich 2004, p. 26
Developed to analyze retentions (deductibles) of original insureds.
3.7 Pricing nonproportional r/i
3.7.7 Pay back rating (I)

- Applying as rating method
  - Experiences, statistics, meteorological, geologic, or other models retrieve expected return periods
  - Question: “Within what period shall a r/i total loss* be “paid back” by r/i premium?“
  - Expected loss in amount ≈ \[
    \frac{r/i \text{ cover}}{\text{expected return period (in years)}}
  \]
3.7 Pricing nonproportional r/i

3.7.7 Pay back rating (II)

- Applying as plausi-check of r/i price
  - Return period \( \approx \) \( \frac{r/i \text{ cover}}{r/i \text{ premium in amount (with or w/o loading)}} \)

- Applying as rating methodology is possible if partial losses are integrated as well (e.g. earthquake with different intensities)
3.7 Pricing nonproportional r/i
3.7.8 Loadings

- Determining further loadings/discounts
  - Fluctuation or safety loading
  - Loading for expenses and capital cost
  - Maybe discount for anticipated investment income
  - Maybe discount for cover limitations (reinstatements, annual limits, etc.)
  - Loading for profit (usually greater than zero)

- In practice there are different “premium principles” (however the loading as such, i.e. in amount, is key)
3.7 Pricing nonproportional r/i
3.7.9 Further price components (I)

- Types of r/i premium
  - Fixed amount
  - Fixed rate
  - Sliding rate ("sliding scale")*

- (Excess) loss participation*

- Reinstatement premium (charged reinforcement of "exhausted" r/i cover)

- Rare: Profit commission or no claims boni

Ad *): See short remarks on the following slide.
3.7 Pricing nonproportional r/i

3.7.9 Further price components (II)

- Sliding scale
  - R/I premium rate according to realized burning cost
  - Reducing the forecast problem regarding the loss burden to r/i layer
  - Reducing moral hazard; bridging loss perception gap

- (Excess) loss participation
  - Insurer participates at every excess loss to layer (e.g. 5-10%)
  - Reducing moral hazard; bridging loss perception gap
CHAPTER 3*: Reinsurance programs

Alternative risk transfer

Reinsurance programs

Proportional reinsurance

Nonproportional reinsurance

“Traditional” reinsurance

Fundamentals of risk management

Excursion: R/I programs

3*.1 Types of agreements

- Reminder
  - Obligatory r/i: mandatory cession and acceptance
  - Facultative r/i: freedom to cede and to accept

- Combinations
  - Fac/obl exist rarely; obl/fac do not exist in practice
  - Any combinations possible:
    - Portfolios of “regular” risks with obligatory r/i
    - Single “special” risks with facultative r/i
Excursion: R/I programs

“Technical” types

- Combinations
  - Principle 1: Proportional r/i before nonproportional r/i
  - Principle 2: Per event XL after per risk XL
  - Principle 3: Stop loss applying as last r/i technique
  - With these principles any* combinations possible
  - Examples: Quota share before nonproportional r/i, per event XL after per risk XL

- Note
  - The combination of risk mitigation options allows for optimal, i.e. target consistent, risk management

Ad *): There are 39(!) combinations of the basic r/i techniques.
Excursion: R/I programs

Evaluate and optimize (I)

- R/I changes result position and risk position (see section 2.2.1)

- "better": Same risk with higher return

- "better": Same return with lower risk

How to compare these two?
3* Excursion: R/I programs
3*.3 Evaluating and optimizing (II)

- Cost and benefit of r/i
  - Cost: Expected “loading“ for the reinsurer
  - Benefit: Risk transfer – e.g. risk capital reduction

- Exemplary preference functionals (see section 2.4.4)
  - “Relative” measure: Risk adjusted return
    
    $$
    \text{RoRAC} := \frac{\text{expected result}}{\text{risk adjusted capital}} = \frac{\text{expected result}}{\text{RAC}}
    $$

  - “Absolute” measure: Economic value added (EVA*)
    
    $$
    \text{EVA} := \text{expected result} – \text{cost of capital} = \text{expected result} – \gamma \cdot \text{RAC}
    $$

Ad *): EVA is a Stern Stewart trademark.
3* Excursion: R/I programs
3*.3 Evaluating and optimizing (III)

- Different views on required capital
  - Internal: Economic and risk based
  - Convergence with Solvency II and internal models
  - Convergence with fair value accounting and “ERM”?

- External: Regulatory
- External: Accounting Rating
3* Excursion: R/I programs
3*.3 Evaluating and optimizing (IV)

- Measuring of “capital efficiency” with internal models

3* Excursion: R/I programs
3*.3 Evaluating and optimizing (V)

- Targets with taking reinsurance to support achieving all corporate targets

- Buying r/i is motivated by various targets

Source: See chapter 3 (section 3.2.1): Targets when buying reinsurance.
CHAPTER 4: Alternative risk transfer

<table>
<thead>
<tr>
<th>Alternative risk transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinsurance programs</td>
</tr>
<tr>
<td>Proportional reinsurance</td>
</tr>
<tr>
<td>Nonproportional reinsurance</td>
</tr>
<tr>
<td>“Traditional” reinsurance</td>
</tr>
<tr>
<td>Fundamentals of risk management</td>
</tr>
</tbody>
</table>
4.1 Basics and definitions (I)

- Let ART be the transfer especially of insurance risks with “alternative” instruments, especially the ones of traditional capital markets

- Further notions: ART is risk transfer with “alternative components”
4.1 Basics and definitions (II)

- Per definition ART serves insurance risk transfer
- Insurer can set “synthetic r/i” with ART

$\text{insurer}$

risk transfer with
$\text{insurance market instruments}$

$\text{risk taker}$

in insurance market

$\text{insurer}$

risk transfer with
$\text{capital market instruments}$

$\text{risk taker}$

investors of capital market
4.2 Purpose and goals
4.2.1 Transfer of insurance risks (II)

- Limits of r/i capacity
  - See also limits of insurability in original insurance
  - Catastrophe potential e.g. earthquake PML in California: 100-150 billion US-

- Idea: Generate additional r/i capacity*
  - traded assets 19,000 billion US-
  - daily standard deviation 133 billion US-
  - insurance industry’s equity 200 billion US-
    (r/i 20 billion US-)

Ad *): Rough comparison of capacities; see sigma 5/1996.
4.2 Purpose and goals
4.2.2 Capital market theory (I)

- Complete capital market
  - Every risky cash flow ("risk") exists in the market and has a (market-) price

- Perfect capital market (friction less)
  - No tax, no information costs or transaction costs
  - Market participant is "price taker" (prices of financial instruments are independent of his/her actions)
  - Every investor can sell or buy arbitrary parts of financial instruments
  - All investors have same market entrance
4.2 Purpose and goals

4.2.2 Capital market theory (II)

- Reality: Capital markets are neither complete (tradability of insurance risks) nor perfect
- In this context, ART supports to complete capital markets (or to "perfectionize" capital markets)
- Insurers and reinsurers featuring ART,
  - can be seen as intermediaries between “traditional” insurance markets and capital markets
  - support efficiency of markets because (in ideal cases) they arbitrage evaluation differences*

Ad *): With simplified focus to price only, the insurer will approach the market where the “cheaper” r/i capacity is available.
4.2 Purpose and goals
4.2.3 Non-monetary goals

- Innovative reputation (assumption in 1990ies)
- Reducing insurance risks
- Generating profits (e.g. with arbitrage profits)
4.3 Classification of types
4.3.1 Capital market instruments

- Main classes: Insurance linked bonds and insurance derivates
4.3 Classification of types
4.3.2 Types of hedges

- Starting point: Occurrence of an insurance event leads to a loss of liquid instruments

*occurrence of an insurance event*

**asset hedge**

\[ E \]

\[ A \to L \]

\[ A_1 \to L \]  

\[ \Delta A \]

\[ \uparrow \]

\[ \text{loss } \Delta A \]

\[ \text{profit } A_2 \]

**liability hedge**

\[ E \]

\[ A \to L \]

\[ A_1 \to L \]  

\[ \Delta A \]

\[ \downarrow \]

\[ \text{loss } \Delta A \]

\[ \text{profit } -L_2 \]

Generating new assets  
- e.g. traditional r/i, PCS cat options*, ...

Reducing exiting liabilities  
- e.g. LPT, insurance linked bonds

Ad *): Historically.
4.4 Insurance linked bonds

4.4.1 Characteristics (I)

- Fixed income securities are characterized by
  - Pay back of the “credit” ("principal")
  - Interest proceedings ("coupons")

- "Insurance link": Linking principal and/or coupons to insurance events
  - If an insurance event occurs, …
  - … the principal goes default (Principal at Risk)
  - … and/or the coupons (Coupon at Risk)
  - … for one/more following periods
  - … in total / partially / not at all
4.4 Insurance linked bonds
4.4.1 Characteristics (II)

- Simple example

Cash flows after issuing (sponsor's perspective)
- Interest spread
- Coupon with part risk free interest
- Interest spread in coupon
- Proceeding of the principal

Cash flows going "default"

Occurrence of a risk event

Time
4.4 Insurance linked bonds
4.4.1 Characteristics (III)

- Empirical examples* for interest rate spreads

spread over LIBOR (bps)

4.4 Insurance linked bonds

4.4.2 Trigger for “insurance link“ (I)

- Characterizing the insurance event*
  - Loss (event) of the individual portfolio (“indemnity based”) or of a virtually constructed insurance portfolio (“modeled loss”)
  - Occurrence of a “physical” event (“parametric”)
  - (Simple) formulae on this basis (“parametric index”)

- Additional links
  - Maybe dependent on time
  - Maybe risk period different from maturity
  - Different tranches for different events

Ad *): Analogous to characterizing an insurance underlying for insurance derivates.
4.4 Insurance linked bonds
4.4.2 Trigger for “insurance link“ (II)

- Clustering trigger types and degree of protection

![Diagram showing clusters of trigger types and degree of protection](image-url)
4.4 Insurance linked bonds
4.4.3 Example of a placement (I)

- Structure with a swap counterparty

4.4 **Insurance linked bonds**

4.4.3 **Example of a placement (II)**

- **Structure without a swap counterparty**


1. The reinsured enters into a risk transfer contract with a special purpose vehicle (SPV).
2. The SPV hedges the contract by issuing notes to investors in the capital markets.
3. Proceeds from the notes are invested in assets to maintain stable value and generate a floating return (the reference rate).
4.4 Insurance linked bonds
4.4.3 Example of a placement (III)

- $(P + \sum_i k_i)$
- insurer (with retention)
- reinsurer (with retention)
- special purpose vehicle
- trust (government papers)
- swap

- Investor
- risk modeling
- set up
- IL-bond
- LIBOR +
- rating agency
- re-financing

LIBOR versus fixed interests of government papers; alignment of timing

Ad *): In some cases adaptions in the aftermath of financial markets turmoil.
4.5 Further examples
4.5.1 Alternative capital

- Alternative capital
  - (Re-) Insurance (partially also insurance linked bonds) provides "traditional" capital for risk transfer
  - Investors and fund managers continue to like insurance risk due to diversification and still superior returns in comparison to e.g. corporate bonds
  - This additional capital which is available for bearing insurance risks is called "alternative capital"

- This capital and its investors enhance efficiency of the traditional reinsurance markets; in regular markets it will stick around sustainably.
4.5 Further examples

4.5.2 Headlines only…

- Insurance derivatives
  - Derivatives on insurance related underlyings (e.g. loss derivatives)
  - Exchange traded only historically (e.g. PCS options)
  - Over the counter (limited public disclosure)

- Risk swaps
  - Mutual exchange of insurance risks

- Contingent financing
  - e.g. catastrophe equity put options (right to emit new own shares)
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APPENDIX
A.1 Epilogue

- This lecture captures the basic fundamentals of risk management with r/i only.
- In practice you will find options, which transfer
  - risks of several lines of business (multi line)
  - risks of several periods (multi year)
  - based on several triggers, insurance and investment driven ones, (multi trigger)
  - with limitations of insurance risk transfer (finite)
  - via special purpose vehicles (professional r/i)
  - into capital markets (ART).
A.2 Insurance risk

A.2.1 Farny’s notion

- Accepting many single loss distributions does not lead to a specific total loss, but to a probability distribution of total losses
- Founded in potential deviations of the collective real total loss from the collective expected total loss
- Insurance risk := Distribution of losses from risk business of an insurer [measuring $P(S > E(S))$]
- Components: Random risks / risk of change / risk of error
A.2 Insurance risk
A.2.2 Albrecht/Schwake’s notion

- Insurance risk := Potential that for a specified period the total loss of the insured portfolio (collective) exceeds the sum of
  - collective risk premium and
  - available safety capital
    [measuring \( P(S > \pi(S) + R) \)]

- Components: Random risks, risk of error (risk of diagnosis and risk of prognosis); note: Different notion of terms of the components between the authors
A.2 Insurance risk
A.2.3 Helten’s notion (I)

- Insurance risk := lack of information with respect to the true collective total loss and the resulting deviation of targets of the insurer
  - Target: Maximizing the expected profit $S - E(S)$
    [$\rightarrow$ Farny]
  - Target: Maximizing the expected safety capital
    [$\rightarrow$ Albrecht/Schwake]
A.2 Insurance risk
A.2.3 Helten’s notion (II)

- Components: Risk of diagnosis / risk of prognosis
A.3 Insurance as risk reserve generator (I)

- Insurer organizes collective financial risk reserve generation for insureds
- Insurer provides start risk reserve for guarantee purposes
- All insureds pay fixed premiums to the risk reserve
- Insurer invests risk reserve (insurance as coupled production)
- Risk reserve finances stochastic insurance losses of a few insureds
- Maybe: Owners provide additional risk reserve
A.3 Insurance as risk reserve generator (II)

- Visualizing the simplest form

Determined premiums of all insureds

Stochastic insurance compensations to a few insureds

“maybe” additional provision of risk reserves

deterministic: Capital for establishment

stochastic: e.g. loss participation in mutuals

A.4 Types of risk mitigations (I)

- Heilmann
  - Risk control (avoidance, reduction, limitation, split)
  - Risk financing (transfer)

- Helten
  - Risk avoidance, risk reduction, risk sharing, risk transfer
  - Cause-related and effect-related mitigation options
  - Risk avoidance, change of targets, risk communication, risk transfer, risk financing
A.4 Types of risk mitigations (II)

- Axiomatic approach
  - Change of lack of information
  - Change of targets (or level of thresholds)
A.5 Alternatives to r/i
A.5.1 Co-insurance (I)

- Co-insurance
  - An insured entity is insured by more insurers
  - Each insurer participates at the insurance contract with a certain percentage

- Example
  - Larger commercial or industrial clients

- Note
  - Partial participation as risk mitigation option of the insurer
A.5 Alternatives to r/i
A.5.1 Co-insurance (II)

- Simplified scheme of risk sharing
A.5 Alternatives to r/i
A.5.2 Insurance pools (I)

- Insurance pool
  - Cooperation of several insurers and/or reinsurers in order to jointly cover insurance (peak) risks
  - Pool is only “organizer” of risk sharing (pool is characterized by a treaty of the engaged parties)

- Examples
  - Nuclear pool, pharma pool, longterm care pool
  - In former times: Aviation pool
  - Other countries: Terrorism pools, elementary perils pool
A.5 Alternatives to r/i
A.5.2 Insurance pools (II)

- Simplified scheme of risk sharing

1 insurance contract

insured

risk sharing (pool)

pool-insurer

pool-insurer

pool-insurer
A.5 Alternatives to r/i
A.5.3 Reinsurance captives (I)

- Primary insurance captives
  - Insurer established or bought/owned by insured
  - Risk management option: Self insurance / internal collective (or individual) financial risk reserve generation
  - Financial and/or tax motivations are important
  - Reduction of acquisition and (parts of) administrative costs
  - “Neutral“ example: Pensionssicherungsverein (captive to protect occupational benefit schemes)
A.5 Alternatives to r/i
A.5.3 Reinsurance captives (II)

- Reinsurance captives
- Analogous to primary insurance captives (owned by large insurance groups)
- Examples:
  - “Dedicated reinsurance entity” in insurance groups
  - Special purpose vehicle in context of ART
  - …
A.6 Examples for types of r/i

A.6.1 Quota share

**Example 1**
- Insured entity $R_1$ sum insured 100’
- Insured entity $R_2$ sum insured 50’
- Insured entity $R_3$ sum insured 10’
- Quota share 60% (cession rate)
- Losses 1.000 for $R_1$, $R_2$, $R_3$
- R/I cover for $R_1$, $R_2$, $R_3$ 600
- Premium 100 for $R_1$, $R_2$, $R_3$
- R/I premium 60 for $R_1$, $R_2$, $R_3$

**Example 2**
- Insured entity $R_1$ sum insured 100’
- Insured entity $R_2$ sum insured 50’
- Insured entity $R_3$ sum insured 10’
- Quota share 60% (cession rate)
- Limit 80’
- Losses 1.000 for $R_1$, $R_2$, $R_3$
- R/I cover for $R_1$ 480
- R/I cover for $R_2$, $R_3$ 600
- Premium analogous to losses
A.6 Examples for types of r/i
A.6.2 Surplus

Example
• Insured entity $R_1$ sum insured 100,000
• Insured entity $R_2$ sum insured 50,000
• Insured entity $R_3$ sum insured 10,000

• Insurer’s line 20,000
• Reinsurer’s cover 3 lines

• Losses 1,000 for $R_1$, $R_2$, $R_3$
• R/I cover for $R_1$ 600
• R/I cover for $R_2$ 600
• R/I cover for $R_3$ 0

Hint: (like quota share)
Calculate the split of obligations

With this idea, the methodology can be applied for PML also.
A.6 Examples for types of r/i
A.6.3 Per risk excess of loss

Example
• Per risk excess of loss 500‘ xs 100‘

• Net loss $x_1$ 90‘
• Net loss $x_2$ 500‘
• Net loss $x_3$ 650‘

• Loss split $x_1$: Insurer 90  reinsurer 0‘
• Loss split $x_1$: Insurer 100 reinsurer 400‘
• Loss split $x_1$: Insurer 150 reinsurer 500‘
A.6  Examples for types of r/i
A.6.4 Per event excess of loss

• Per event excess of loss 5.000‘ xs 1.000‘
  (assume no other nonproportional r/i is in place)

Example 1
• One event triggers single losses
  \[ x_1 \; 400‘ \]
  \[ x_2 \; 800‘ \]
• Accumulated event loss 1.200‘
• Loss split: Insurer 1.000‘
  reinsurer 200‘

Example 2
• One event triggers single losses
  \[ x_1 \; 1.000‘ \]
  \[ x_1 \; 2.800‘ \]
  \[ x_2 \; 3.000‘ \]
• Accumulated event loss 6.800‘
• Loss split: Insurer 1.800‘
  reinsurer 5.000‘
A.6 Examples for types of r/i
A.6.5 Stop loss

• Stop loss 50% xs 75%
  (relative to protected premium volume (see loss ratio)

• Plausi-check: 100% protected premium volume
  (modified combined ratio)
  - 30% prop. r/i commission (proxy expenses insurer)
  - 10% r/i premium for stop loss
  = 60% loss ratio insurer “without negative result”

• Loss ratio $q_1$ 70%:
  - underwriting loss insurer approx. 10%
  - no r/i compensation

• Loss ratio $q_2$ 100%:
  - at first underwriting loss insurer approx. 40%
  - r/i compensation 25%
  - “usually”: loss is stopped at 15%

• Loss ratio $q_3$ 200%:
  - at first underwriting loss insurer approx. 140%
  - r/i compensation 50%
  - insurer’s retention 150%; loss approx. 90%
A.6 Examples for types of r/i
A.6.6 Insurance derivatives (I)

- Derivative financial instruments: Instruments derived from an underlying with a price depending on the price of the underlying
  - Integrating insurance risk (e.g. losses) in underlying
  - “Traditional” derivatives upon this underlying
  - Outcome: Traditional financial instrument features a link to insurance risks (insurance derivatives)

- Exchange traded examples (historically):
  - PCS options at CBOT (www.cbot.com/)
  - GCCI derivatives at BCOE (www.bcoe.bm/)
A.6 Examples for types of r/i
A.6.6 Insurance derivatives (II)

- Placing arbitrary derivatives on insurance underlyings

- financial market
  - money market
  - capital market
    - Terminmarkt
      - commodities
      - unconditional instruments
        - forwards (over the counter)
        - futures (exchange traded)
      - financial
        - swaps
        - options
          - over the counter options
          - exchange traded options
    - Kassamarkt
      - conditional instruments
        - caps, floors, collars
A.6 Examples for types of r/i
A.6.6 Insurance derivatives (III)

- Characterizing the insurance underlying* according to the coverage of traditional r/i
  - logical specification (e.g. lines of business, perils)
  - geographical specification (e.g. regions, countries)

- Reference variables for insurance underlyings
  - Economic versus insurance perspective
  - Known versus estimated versus “expected values
  - In amount versus relative variables (e.g. loss ratio)
  - Market versus individual references

Ad *): Similar as the specification of the triggering event at insurance linked bonds.
A.6 Examples for types of r/i
A.6.6 Insurance derivatives (IV)

- Historically: PCS cat options Chicago Board of Trade

- Time specification
- Space specification
- Business specification

- Cat losses
- PCS index
- Insurance underlying

- Insurers’ reports (70% market share)
- Investigations of PCS “on site”
- Estimations of PCS

Transformation (truncation etc.)

Example
A.6 Examples for types of r/i
A.6.6 Insurance derivatives (V)

• 20/50 PCS cat call spread (long position)

\[
(50-20) \times 200 \text{ US }\$ = 6,000 \text{ US }\$
\]

value: 1 point = 200 US-

• If the PCS loss is below 200 million US-

• If the PCS loss is above 500 million US-

option occurs, i.e. 6,000 US-

Index as at “maturity”

Index:

1 point = 10 million US-

option premium

attachment point 20

exit point 50

with option premium

without option premium
A.7 Some further literature
A.7.1 Risk management (I)


- KPMG Deutsche Treuhand Gruppe: Integriertes Risikomanagement, Berlin 1998
A.7 Some further literature
A.7.1 Risk management (II)


- Helten, Elmar; Bittl, Andreas; Liebwein, Peter: Versichern von Risiken, in: Dörner, Dietrich; Horváth, Peter; Kagermann, Henning (Hrsg.): Praxis des Risikomanagements, Stuttgart 2000, S. 153-191
A.7 Some further literature
A.7.2 Traditional r/i (I)

- Pfeiffer, Christoph: Einführung in die Rückversicherung, 3.(I) und 5. Auflage, Wiesbaden 1999
- Swiss Re (Hrsg.): Reinsurance matters: A manual of the non-life branches, Zürich 2005
A.7 Some further literature
A.7.2 Traditional r/i (II)

- Liebwein, Peter: Klassische und moderne Formen der Rückversicherung, 2nd edition, Karlsruhe 2009
- Schwepcke, Andreas et al.: Rückversicherung: Grundlagen und aktuelles Wissen, Karlsruhe 2001
A.7 Some further literature
A.7.2 Traditional r/i (III)

- Barile, Andrew: 

- Heß, Andrea: 
  Financial Reinsurance, Karlsruhe 1998

- Monti, George R. und Barile, Andrew: 

- Swiss Re: 
  Overview: sigma 1/2003; more detailed & better: sigma 7/2006, 5/1996 (ART); sigma 5/1997 (FinRe)
A.7 Some further literature
A.7.3 Alternative risk transfer (I)


A.7 Some further literature
A.7.3 Alternative risk transfer (II)

- Munich RE: Risikotransfer in den Kapitalmarkt, Munich 2001 (http://www.munichre.com)
- Swiss Re: Insurance Linked Securities, Zürich 2001 und Zurich 2005 (Print)
- Swiss Re: ART-Bestandsaufnahme, sigma 1/2003
A.8 Your trainer

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  - 1991-1996: Diploma ("master") in mathematics
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