Reinsurance

Property Insurance Simulation Game

IRIS Insurance® Game

Peter Liebwein
Ralf Klotzbücher
Keith Purvis

podra

riva

Contents

Reinsurance basics

How does the reinsurance market operate?

What is reinsurance?

Robert Kiln, a famous underwriter at Lloyd's, gave us perhaps the shortest and simplest **definition of reinsurance** when he called it "the insurance of an insurance company". The insurance company, that in the reinsurance relationship is usually either called the **direct or primary insurer** or **cedent**, transfers part of a risk or class of risks to a reinsurance company, that is usually called the **reinsurer**.

Broadly, there are two possible ways in which this can be done. In return for taking over part of the risk and paying a share of any claims, the reinsurer receives the same share of the premium which the direct insurer has collected from the insured.
Alternatively, instead of transferring a proportion of the risk, the direct insurer may pay the reinsurer a reinsurance premium in return for a promise by the reinsurer to pay claims above a certain amount that could occur. You will learn about both techniques in the course of this introduction to reinsurance, and then you will have the chance to practice them in the Property & Casualty Insurance Simulation.

It is important to realize that the obligation of the insurance company to the policyholder remains the same, with or without reinsurance. The reinsurer's contractual relationship is with the direct insurer, not the insured. This means that if a reinsurer goes default, the insurance company would still be liable to its policyholders. For this reason security is an important issue for an insurance company in its choice of reinsurers.

Creating global risk transfer-networks

An insurance market consists of insurance companies, reinsurers and the reinsurers of reinsurers, that are called **retrocessionaires**. Insurance companies almost always reinsure their business in some way (**outwards reinsurance**). Sometimes they also provide reinsurance for other companies: that is, they accept **inwards reinsurance**. They are then themselves reinsurers as well as direct insurers.

Professional reinsurers are companies that only do reinsurance and do not accept direct business. Most reinsurers – whether direct companies that accept inwards reinsurance or professional reinsurers – will **retrocede** part of the reinsurance business they write. That is, they reinsure part of what they have reinsured. In this way the insurance market divides even the largest risks that could ruin any one company into small digestible portions. This process is called designing (re-) insurance portfolios **or diversification**.

The nature of risk transfer is slightly different, depending on whether the risks are domestic (Figure 1 below) or industrial (Figure 2). Commercial risks may belong to either category, depending on size.

Figure 1 shows the transfer of relatively small risks that become concentrated in an insurance company's portfolio. The process of designing (re-) insurance portfolios and **diversification** begins with reinsurance and is continued with **retrocession**.

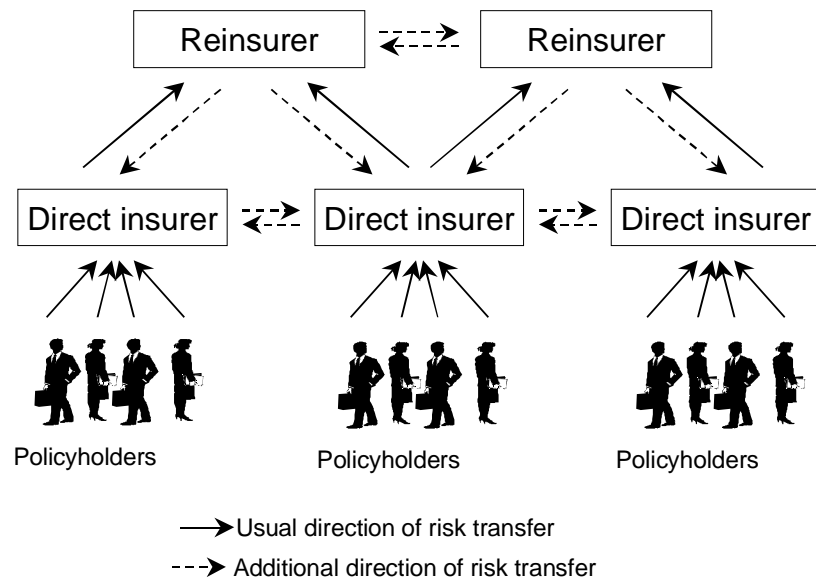Figure 1: Building portfolios and diversification

Figure 2 shows large risks, such as factories, ships or satellites where the atomization begins with the direct insurer. That is, the insurance of such risks is often shared with other insurance companies. This is called **co-insurance**. The process of atomization is continued by means of reinsurance and retrocession.
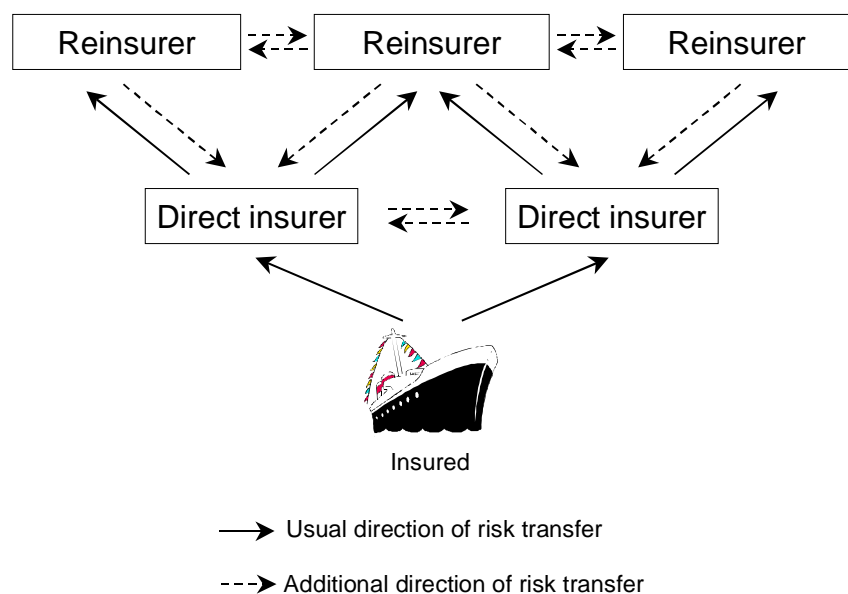

Figure 2: Atomization and co-(re-)insurance

The broken arrows in the illustrations indicate that direct insurers (and also reinsurers) obtain reinsurance from other direct insurers and from reinsurers.

Although most of these involved insurance and reinsurance companies will be in competition with each other, they recognize that they need each other to survive, and they co-operate to produce a **complex and global network of risk transfer** that is homeostatic in nature. That is, the insurance market perpetually strives to achieve stable risk conditions. It never achieves it, which is why reinsurance is so important. You will learn about alternative concepts later in this reading.

Reinsurance market-cycles?

There are market participants, who believe in cycles in reinsurance markets and therefore perceive cyclic behavior of however normalized reinsurance prices. This perception is based on the following utopia which goes back to the cob-web model. When reinsurance capacity is scarce, reinsurance premiums rise; insurance companies or new founded reinsurers are attracted to the reinsurance market and enter it. When this happens, capacity is no longer scarce, and premiums rates sink to an unacceptably low level, and then losses are made. The insurance companies that had been attracted into the market by high premium rates a few years earlier then leave it, and the premium rates rise again. Then the cycle repeats itself.

It is beyond doubt that there are price movements, that suppliers of reinsurance capacity come and go to some extent. Furthermore it is beyond doubt that reinsurance market prices are defined usually only once a year in renewal season and therefore is characterized by information inefficiencies or information time lags which reflect the cob-web model. However, it is also beyond any doubt, that broad areas of the reinsurance markets show severe random fluctuations due to severe underwriting risks.

In the insurance game you will see fluctuating results and will try to equalize them over time with your reinsurance partner; it is up to you whether you then perceive reinsurance market price cycles or not.

Why do insurance companies buy reinsurance?

Control and transfer the underwriting risk

When an insurance company calculates its risk premium – that is, the premium that should be just sufficient to cover expected losses – two factors are of fundamental importance: The **severity** of expected losses and their **frequency** of occurrence. This risk premium will then be loaded with various safety and profit margins and expense loadings. The property & casualty insurance companies for which you are responsible have calculated the premiums for all three categories of business in this way. So can you now sleep easy, or could something unexpected happen to disturb your dreams?

Unfortunately, your companies could still lose money or even face ruin as a result of unfavorable events over which you have very little or no control. We can put these threats to your insurance company's financial viability into three categories.

(1) Risk of Random Events

The risk that one particularly expensive unit in an insurance portfolio will be lost instead of one with an average sum insured can be called the **"risk of random single losses"**: in other words, bad luck! This happens in domestic business when one or more of the most expensive houses in the portfolio of business are destroyed, or in commercial business when an office block burns down or in industrial business when a factory is severely damaged. The risk of random loss means that actual loss severity is greater than the expected loss severity.

Another way of being hit by bad luck, or random events, is the **"risk of random accumulation of losses"**, e.g. due to a catastrophe of some kind. It can be man-made, but more often the cause is a natural event, such as an earthquake or a storm, and we all know that such risks are increasing in severity. Even a carefully underwritten portfolio of risks can suffer catastrophic losses if more than the expected number of units are destroyed in one event. Of all the scenarios that could hit you, a natural catastrophe is the worst, because it may well mean high severity and with a low frequency – which means hard to assess.

The following table of the 15 most expensive insurance losses in the period 1970-2008 shows, that random events –single large losses or severe accumulation losses – may "eat up" the entire premium volume of single insurance companies or even the entire insurance market segment:

Insured loss¹ in USD m, indexed to 2008	Victims²	Date [start]	Event	Country
71 300	1 838	25.08.2005	Hurricane Katrina; floods, dama burst, damage to oil rigs	US, Gulf of Mexico, Bahamas, North Atlantic
24 552	43	23.08.1992	Hurricane Andrew; floods	US, Bahamas
22 035	2 982	11.09.2001	Terror attack on WTC, Pentagon and other buildings	US
20 237	61	17.01.1994	Northridge earthquake (M 6.6)	US
20 000	186	06.09.2008	Hurricane Ike; floods, offshore damage	US, Caribbean; Gulf of Mexico et al
14 680	124	02.08.2004	Hurricane Ivan; damage to oil rigs	US, Caribbean; Barbados et al
13 847	35	19.10.2005	Hurricane Wilma; torrential rain, floods	US, Mexico, Jamaica, Haiti et al
11 122	34	20.09.2005	Hurricane Rita; floods, damage to oil rigs	US, Gulf of Mexico, Cuba
9 148	24	11.08.2004	Hurricane Charley; floods	US, Cuba, Jamaica et al
8 908	51	27.09.1991	Typhoon Mireille/No 19	Japan
7 900	71	15.09.1989	Hurricane Hugo	US, Puerto Rico et al
7 895	95	25.01.1990	Winter storm Daria	France, UK, Belgium, NL et al
7 497	110	25.12.1999	Winter storm Lothar	Switzerland, UK, France et al
6 329	54	18.01.2007	Winter storm Kyrill; floods	Germany, UK, NL, Belgium et al
6 875	22	15.10.1987	Storm and floods in Europe	France, UK, Netherlands et al

Source: Sigma, Swiss Re.

(2) Risk of Change

It is also interesting to take a look at the number of catastrophe losses in the period 1970-2008:
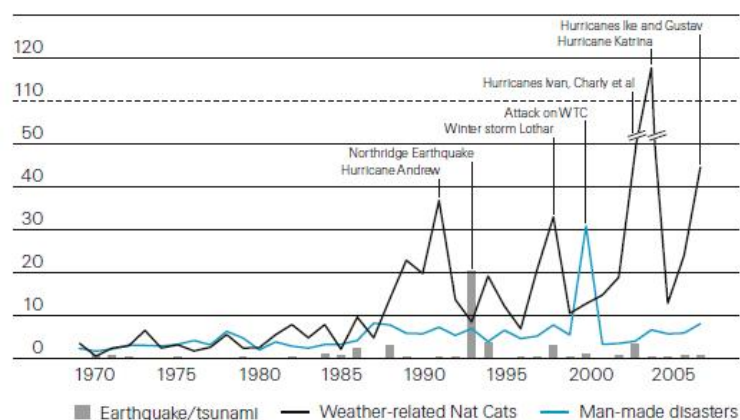
Source: Sigma, Swiss Re

This table induces that the losses become more and more expensive and that the number of losses increases non-linearly. Perhaps the premiums were high enough when your underwriters calculated them, but over time something may have occurred that makes them inadequate. When this happens, you will probably notice an increase in the frequency of claims.

In general, this could happen for very many reasons. Perhaps there is a steady increase of insured values or an increase of frequency or severity of claims. Losses can become more expensive because of several developments such as inflation, higher compensation payments (see US liability court decisions) or structural changes in technology, economics or the insurance markets (see medical technologies, alternative energy, nanotechnology etc.).

---

(3)   Risk of Error

Your company may have calculated its premiums with care on the basis of available knowledge, but it could still be wrong. Especially if you are introducing a new type of policy – a common event in today's innovative markets – you can never be absolutely sure that the premiums are correct. The likely result of the risk of error will be a higher frequency or higher severity of loss than your underwriters had calculated.

A reinsurance program reduces the **fluctuations** in severity and frequency of loss events, and this in turn stabilizes results, equalizing the profit and loss, protecting the balance sheet and reducing the risk of ruin.

Transferring the **underwriting risk** is the most important feature that reinsurers provide to the insurance market. There are also other important ones, and these follow below.

Manage regulatory capital requirements

Either as a consequence of insurance risk transfer or as a driving force, there are regulatory reasons for taking reinsurance.

All countries have supervisory "safety" regulations to make sure that insurance companies meet their liabilities of the policyholders on a sustainable basis. These regulations can be clustered according to three pillars:

- Pillar one (quantitative requirements): These regulations especially require a target or a minimum capital base (available risk capital has to exceed required risk capital) in context of the entire risk position of the insurance company; in addition there are regulations how to measure technical provisions (insurance liabilities) in the supervisory balance sheet (or more general, how to measure all assets and liabilities – the difference being the available own funds).

- Pillar two (qualitative requirements): This pillar captures amongst other things requirements for corporate risk management, i.e. for processes to identify, quantify, and control risks; furthermore this pillar defines supervisory interventions and cross-country as well as cross-sectoral cooperation of supervisory authorities.

- Pillar three (transparency requirements): Finally necessary disclosures for supervisory authorities and other stakeholders of the insurance company are regulated. This transparency shall set incentives for market discipline of the companies.

Within the first pillar of quantitative regulations, one part is the (target) capital requirement. Basically, the target capital requirement induces a risk capital base to have an annual default probability of at maximum 0.5% (i.e. we survive all events up to the "200 years event"). The required risk capital is based on the entire risk position oft he insurance company. For this entire risk position the following risks are explicitly tob e measured:

- Insurance (or in short underwriting) risks for property and casualty insurance (especially catastrophe risks and premium/reserve risks),

for life insurance (especially mortaility and longevity risks, cat risks and lapse risks), and for health insurance (especially morbidity risks and other risks). Within this framework, reinsurance is taken into account; **reinsurance transfers and thus mitigates insurance risks and therefore reduces required risk capita** accordingly.

- Investment risks (so called market risks), capturing interest rate change risks, market price risks for stocks or real estate and other risks.

- Counterparty default risks, i.e. risks that outstandings or recoverables may not be recovered anymore. Bonds and reinsurance recoverables (retrospective as reserves or prospective as active reinsurance covers) are the key drivers of counterparty default risks. For both drivers, the default of the respective counterparty leads to a potential loss to the insurance company.

- Further components like e.g. operational risks, risk mitigating effects of profit sharing insurance products which may be reduced in case of an adverse situation to the company.

As highlighted above, reinsurance with transfer of insurance risks is reflected in supervisory risk capital requirements. (For the event that this risk mitigation would not work, the counterparty default risk increases, however usually on a very remote basis in comparison to the risk capital relief due to the transfer of insurance risks). Within this context, reinsurance is also used for **capital steering** purposes; in general this affects not only supervisory capital, but also economic capital, accounting based capital, or rating capital 8if the company is rated).

The P&C Insurance Simulation Game features similar supervisory requirements regarding the target risk capital and minimum risk capital

Maybe your available risk capital will melt down e.g. in growth phases or in other situations.

Of course you can then use – just like in reality – reinsurance in order to meet the regulatory capital requirements.

Please note that you have to elaborate and to manage the "true" causes of solvency problems,

Let us generalize capital steering in terms of reducing (regulatory) risk capital requirements. Reinsurance can also be used – or deliberately not used – in order to **increase capital efficiency**. Reduced requirements of risk capital induce, that less risk capital needs to be provided and thus less interest or return has to be provided for this risk capital. Therefore risk capital costs are reduced for the insurance company. As a next step, these reduced capital costs have to be compared with the according costs of risk mitigation, i.e. in our case costs for reinsurance.

Supporting corporate steering and corporate strategy

Based on regulatory motivations for capital steering, reinsurance can be embedded into holistic and strategy related coprorate steering frameworks.

The most simple approximation – the so called **"x%-rule"** – shows the relation of (growth) strategy, corporate finance, and risk management (here as risk transfer by reinsurance):

$$\frac{\text{Available own funds}}{\text{Gross premium volume minus outwards reinsurance premiums}} \overset{!}{\geq} x\%$$

In the denominator premiums for outwards reinsurance are deducted, therefore it is clear that reinsurance can (i) compensate for higher requirements regarding own funds, or (ii) support a growth strategy triggering higher gross premium volume, without violating the "x%-rule". If we generalize the components of the "x%-rule", we can summarize the following effects:

1. Steering own funds is related with keeping or paying out positive results from or to the owners as well as with corporate finance in terms of equity, hybrid capital or certain debt capital.

2. The gross premium volume is simply representing the entire risk position of the insurance company which is a result of corporate strategy.

3. The reinsurance premiums in turn is representing the risk mitigation by reinsurance, respectively the corporate risk management as such.

To summarize: Corporate strategy, corporate finance, and corporate risk management – with reinsurance being a key component – are strongly related with each other. Therefore reinsurance buying can be motivated in context of a holistic corporate steering framework.

Accessing reinsurance services

Professional reinsurers are able to provide various consultancy services for direct insurers. They help to improve the reinsurance administering processes as well as the quality even in the direct insurance business. The following services are the most common, but the list is by no means complete:

- Giving advice about and supporting the construction of the portfolio of business, the formulation of the underwriting policy and the reinsurance program.

- New product development and the communication of knowledge about different types of policy gained from other insurance markets.

- Profit testing of reinsured portfolios as well as new policy types.

- Analyzing and underwriting especially difficult or unusual risks.

- Giving advice and co-operating in the investigation, prevention and settling of claims.

- Training the staff not only of ceding companies, but sometimes also of potential customers.

- Giving advice about various things, such as the organization of sales and marketing and internal operations, investments, the foundation of insurance companies, and so on.

- Giving advice on the use of IT systems and the development of expert systems.

Unfortunately, or fortunately, it's not about the reinsurer being smarter than the primary insurer. Reinsurers take over and manage different types of (insurance) risks and therefore may have complementary experience. For the primary insurer it boils down to the question "make or buy" (i.e. building up own expert bases versus using other providers of the according expertise). For the reinsurer it boils down to the business model, i.e. just providing reinsurance capacity or providing a full range of services (explicitly or implicitly paid for).

Empirical survey of reinsurance buying motivations

Helten conducted two empirical surveys in 1997 and 1991 in order to measure the driving forces for buying reinsurance in Germany. See Helten (1999), p. 58, and Schenk (1999), p. 366.

The following table summarizes the (average) importance oft he drivers when buying reinsurance Both surveys
(Importance of the driver ranges from 1 (not important at all) to 5 (very important))

Driving motivation for buying reinsurance	μ 1979	μ 1991	"trend"
Reducing insurance risks	4,22	4,62	+
Ceding periodic excess losses	3,20	3,73	+
Increasing underwriting capacity	3,58	3,51	-
Achieving a positive underwriting result	3,40	3,49	+
Sharing of expected losses	2,89	3,38	+
Maintaining personal and fact based relationships	3,31	3,19	-
Getting reinsurance services	2,36	3,16	+
Reducing expense ratios for own account	3,09	2,92	-
Increasing relation equity over premiums for own account	2,62	2,89	+
Meeting solvency requirements	2,09	2,62	+
Achieving group targets	2,40	2,51	+
Avoiding liquidity shortfalls	2,09	2,46	+
Getting reciprocity business	2,26	1,54	-
Total	***2,54***	***3,07***	***++***

What is relevant in arranging reinsurance programs?

Depending on the targets of reinsurance buyers or sellers and depending on dealing with inwards or outwards reinsurance, there are different key factors that can be taken into account when reinsurance programs are set up or modified:

If you are *buying reinsurance*…

- First analyze the **underwriting risks** in your portfolios (Industrial, Commercial and Domestic) according to whether the threat is the risk of random large losses (or catastrophic accumulating losses), the risk of change or the risk of error.

- Then choose your form of **reinsurance cover** – proportional alone, or proportional and excess of loss for the retention. If you need reinsurance to increase your underwriting capacity and comply with **solvency capital** requirements, you should consider proportional reinsurance.

- Thirdly, observe the **insurance price level (or "market cycles"?)**. If premium rates are high, buy less reinsurance. If they are low (and therefore loss ratios are high), you can buy more.

- Finally, what **services** do you want your reinsurer to give you?

If you are *selling reinsurance*…

- First analyze the **underwriting risks** in the direct insurer's portfolio depending on which risk category it is.

- Examine the **premium volume and loss history** of the portfolio over the last three to five years of business.

- Observe the **insurance price level (or "market cycle"?)**. If premium rates are high, try to sell more reinsurance. If premium rates are low, try to sell less. Remember you can influence the price of reinsurance by your actions. If you offer a great deal of capacity for one risk category, you could bring the rates down. If you limit your capacity, you could help to reduce capacity in the entire reinsurance market and thus rates to rise.

- Think carefully about the effect on your **own risk capital base** if your direct insurer partner wants to buy a large amount of reinsurance to improve its solvency capital requirements.

- Reinsurers that accept more reinsurance from a risk category than they want to keep for their own account arrange for **retrocession (reinsurance of reinsurers)** beforehand.
  Note: In order to avoid "risk transfer spirals" and thus to avoid systemic risks in the Property & Casualty Insurance Simulation, retrocession is not possible.

- Finally, when it comes to **services**, do a cost benefit analysis if a direct insurer wants your company to provide expensive services for it. Is the direct insurer prepared to cede you more good business at a lower commission, for example?

In the Property & Casualty Insurance Simulation there is a chance to prove the statements which seem to be true for many reinsurance markets:

- *"Reinsurance is a gentlemen's agreement."*

- *"Reinsurance is more an art of underwriting people rather than of underwriting facts."*

Thus try to contact your reinsurance partners early and try to create a "win-win-situation" in the long run.

Proportional Reinsurance

Overview

There are two basic concepts of reinsurance techniques: Proportional and non-proportional reinsurance. In this section you will learn the basic ideas of proportional reinsurance, where as the next section provides the ideas of non-proportional reinsurance.

In **proportional reinsurance** risks are split up between direct insurer and reinsurer according to a **ratio of liability** (proportion) – in most cases measured by the sum insured. Once this ratio of liability for the direct insurer's account and for the reinsurer's account is determined, the effect of proportional reinsurance is fully transparent: the reinsurer is liable for its proportion of risks insured and therefore gets a proportion of original premiums and pays a proportion of original claims.

The different types of proportional reinsurance treaties simply use different techniques in determining the ratio of liability with respect to the risks insured.

To summarize:

- Proportional reinsurance is based on the original sum insured.
- Proportional reinsurance shares liabilities.
- The proportion in which the liability is shared determines the sharing of premiums and claims.

Quota share

Concept

In a **quota share treaty** the reinsurer participates in each unit that comes within the treaty with a fixed percentage. (See illustration).
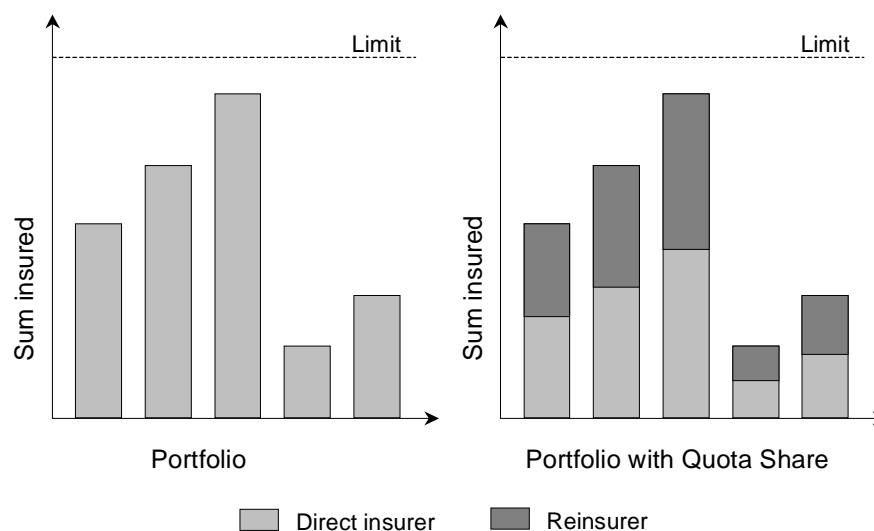
The **retention** of the direct insurer is expressed as a percentage of the original sum insured. The retention should not be less than ca. 5 - 10% of the sum insured, however, because the direct insurer's share would otherwise be so small that it might lose interest in controlling the business properly.

With a quota share the reinsurer's liability is limited by an absolute sum insured. This is called the treaty limit. Up to this sum insured risks are shared between direct insurer and reinsurer according to the percentages agreed.

Example: The retention is 20% and so the reinsurer's share of each risk is 80%. The treaty limit is € 1,000,000. For sums insured up to € 1,000,000 the reinsurer covers 80% of the sum insured. In the case of sums insured higher than € 1,000,000, the reinsurer is not liable for that part of the sum insured in excess of € 1,000,000. Thus, for a sum insured of € 1,200,000, the reinsurer would be liable for € 800,000 (i.e. 66.7%) and the direct insurer for € 400,000 (i.e. 33.3%).

Effects

Let us summarize some characteristics, and some pros and cons from the perspective of a primary insurer:

- Quota share reinsurance protects the portfolio against **attrition losses**: that is against high frequency of loss. This would be the case where the premium had been wrongly calculated (**risk of error**) or if some risk feature of the portfolio or its market environment had changed (**risk of change**).

- Quota Share reinsurance protects the direct insurer against an **accumulation** of losses (catastrophe risk). This can be an advantage in hail and storm insurance, because these classes of business are often affected by an accumulation of small and medium sized claims.

- Quota Share reduces the liability of the direct insurer in **absolute** terms.

- With reference to point three above, the reduction in the absolute amount of the liability means that the direct insurer's need for capital is also reduced. It is for this reason that the quota share is often used to provide financial support when a new insurance portfolio is being built up. It can thus be regarded as a substitute for capital (e.g. quota share reinsurance for motor business in the German market).

- The **administration** is simple and inexpensive because in regular cases all risks are shared by the same percentage. This means it is not necessary to calculate the direct insurer's and the reinsurer's respective shares on a per risk basis.

- Reinsurers usually give higher commission for quota share than for other forms of reinsurance. There are three main reasons for this:
  (a) The reinsurer has a share of the small and medium sized claims, which usually are well balanced and produce stable results.
  (b) There is identity of interest between reinsurer and direct insurer and thus a low level of **moral hazard** („**follow the fortunes**").
  (c) Quota share business can also be easily retroceded, and it also makes reciprocal retrocessions possible.

- There is inadequate protection against severe losses: that is, claims involving risks with high sums insured (**random loss**). This is because under a quota share treaty a portfolio of risks containing very different sums insured is no better balanced than if there were no reinsurance. Variation in the sums insured remains just the same. Consequently, reductions in large claims will only be achieved to a limited extent.

- The direct insurer shares small risks with the reinsurer that it could easily keep itself, thus reducing unnecessarily the volume of premium retained for its own account. (This argument implies, of course, that the direct insurer has written good business that it actually does want to keep: see Advantages, point 1!)

Surplus treaty

Concept

In the case of surplus reinsurance the reinsurer takes a share of only those risks that **exceed** the direct insurer's **retention line**. This line is expressed as an amount in [€]. Risks with sums insured lower than the direct insurer's line are not ceded. Risks with sums insured that exceed the line are **shared** between direct and reinsurer in proportion to the line and the portion of the sum insured that exceeds it.
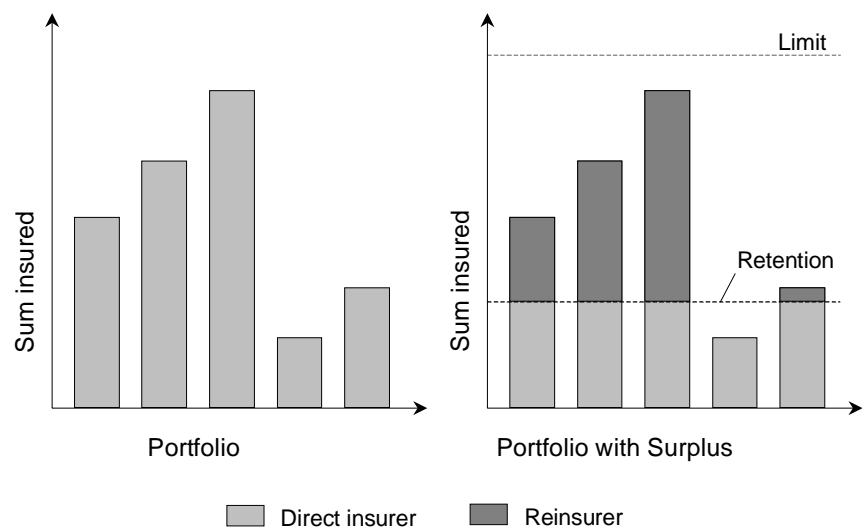
Obviously the reinsurer only participates at "larger" and a smaller number of insured entities, providing high capacities in comparison to the cede premium volume. The primary insurer in turn keeps the stable and usually well performing small and medium sized business within its retention. Usually this leads to better results for the primary insurer in comparison to the reinsurer; in addition, this reinsurance technique potentially sets some incentives, to (consciously or unconsciously) increase adverse selection and moral hazards. Therefore some market participants assume that gradually less and less reinsurers provide capacity for this kind of reinsurance

In the case of the surplus the reinsurer's liability is limited by an agreed **number of lines**, which are multiplications of the retention.

*Example: The sum insured of an industrial risk and a commercial risk is €
1,000,000 resp. € 300.000. The line of a surplus treaty is € 100,000 and
the reinsurance cover is two lines.*

- *Risks in domestic business have sums insured below the
  line. They fully belong to the direct insurer's retention. No
  liability is shared here, therefore.*

- *Risks in commercial business show a liability ratio of 2/3 for
  account of the reinsurer as it covers two lines, i.e. € 200,000,
  of the total sum insured of € 300,000. Obviously the liability
  proportion for account of the direct insurer is 1/3.*

- *The reinsurer bears a liability ratio of 2/10, equals 1/5, in
  respect of risks in industrial business. The remaining
  proportion of 8/10, equal 4/5, is the retention of the direct
  insurer.*
  *Note: These 8/10 are accumulated by 1/10 below the line
  and the exceeding 7/10 above the treaty limit.*

*All original claims and all original premiums, also, are split up according
to these liability ratios.*

Effects

Let us summarize some characteristics, and some pros and cons from
the perspective of a primary insurer:

- Expressing the retention in **absolute** monetary terms results in a well
  balanced retained portfolio of business for the direct insurer. The
  surplus provides protection against severe losses (**risk of random
  loss**). The reinsurer will pay a higher proportion of high and very high
  claims than is the case with quota share reinsurance.

- The direct insurer will keep a higher proportion of the original
  premium, because risks whose sums insured do not exceed the
  retention are not ceded.

- There is some protection against high frequency of loss, because in
  the case of risks that have been ceded, even small losses are shared
  proportionately. Thus the **risk of error** and the risk of change are
  covered to some degree, though to a lesser extent than with quota
  share reinsurance.

- The surplus can increase the direct insurer's **underwriting capacity**,
  though it is not as effective as the quota share in this respect.

- There is only very limited protection against a **catastrophe** that
  causes an accumulation of losses. This is because in a portfolio with
  a normal distribution of sums insured most risks will fall within the
  retention and will not be ceded.

- Because of the proportionality between **retention** and **reinsurance
  capacity**, in order to obtain a large amount of reinsurance cover the

retention may have to be higher than the direct insurer may wish. This problem can be solved if there are several surpluses, however.

- Surplus reinsurance involves more **administration** than is the case with quota share. This is because the proportion shared between the reinsurer and the direct insurer has to be calculated for each individual risk ceded.

- The level of **reinsurance commission** that the direct insurer receives will be less than in the case of a quota share – all other things being equal – because the reinsurer will participate in fewer risks. Furthermore, they will be larger and less well balanced than the risks retained entirely by the direct insurer and its retention on those risks ceded. Thus the lower level of commission reflects the fact that in the case of surplus reinsurance the principle of **"follow the fortunes"** does not operate on a one to one basis.

Layers

There can be **more than one surplus**, one on top of another. A second and third surplus can sit on top of a first surplus, for example. This means that a further surplus covers the cedent when the sum insured exceeds the previous or underlying surplus. For example, if the first surplus covered three lines – i.e. three times the retention – a second surplus might cover two lines. This would mean that the reinsurer covered five lines in all. Thus several surplus treaties can be used to subsequently reinsure larger risks. The diagram shows how this works.
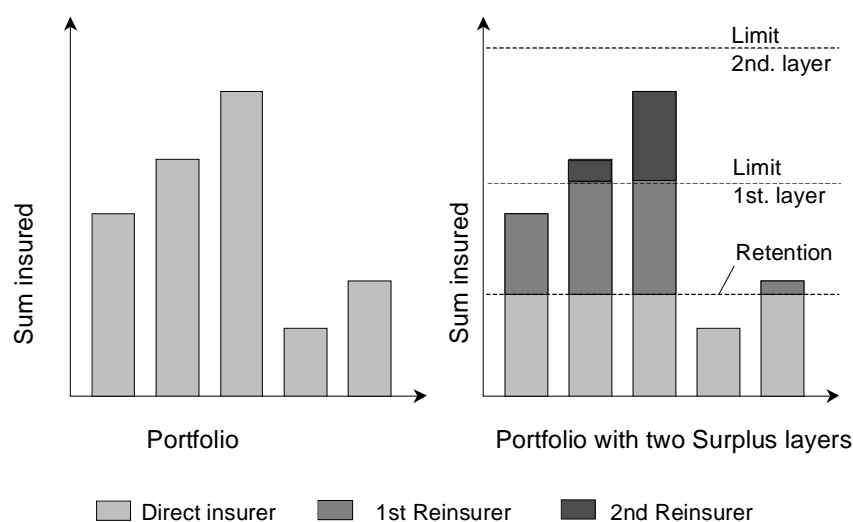
Sharing risks in this way means, that it is easier to maintain an overview, and it could be easier to obtain reinsurance on this basis than if risks were ceded to only one surplus. Frequently, one reinsurer covers the first surplus and a different reinsurer covers the second surplus.

Pricing proportional reinsurance

Share of the original premium

The policyholder pays the direct insurer a premium that is appropriate to the risk. Because the reinsurer takes over a share of this original risk, it is entitled to receive **a proportional share of the original premium**, which the direct insurer accordingly transfers. This proportional share is the major part of the price for proportional reinsurance. It follows, therefore, that the price negotiation between direct insurer and reinsurer concentrates on the reinsurance commission.

Reinsurance commission

Reinsurance commission is the commission paid by a reinsurer to a direct insurer, and it is expressed as a percentage of the premiums ceded. Oversimplified, the reinsurer pays enough commission to cover the **costs** incurred by the direct insurer in acquiring and administering the business ceded.

In real markets reinsurance commission simply serves to determine the **price** of reinsurance and has little to do with the direct insurer's actual costs. As an **insurance principle**, the rate of commission is a consequence of the expected loss ratio of the business. Good reinsurance business allows for higher commissions et vice versa; stable reinsurance business requires less fluctuation loading or risk capital costs, and therefore may allow for higher reinsurance commissions et vice versa.

tip *Even if outdated and an utopia, take the cost ratios of the direct insured as an orientation for the height of the reinsurance commission. Key determinants are loss ratios, original premium rates, fluctuations of losses are which take effect on the reinsurance commission. Also take reinsurance market price levels (cycles?) into account when fixing the commission.*

Of course the definitive height is a matter of negotiation between the direct insurer and the reinsurer. But please, don't forget in what direction you want to bargain...

Profit commission

Profit commission is a percentage of the reinsurer's profit, if any, on the business ceded. It is paid at the end of the treaty year to reward the direct insurer for good business and typically triggers lower fixed commission arrangements in order to have comparable expected total commissions.

In its simplest form a profit commission statement includes the following items:

| Income for the reinsurer	Outgo for the reinsurer
Earned reinsurance premium	Commission
	Claims paid
Loss reserve (in)	Loss reserve (out)
	Reinsurers' expenses
	Reinsurance losses carried forward

The outgo is subtracted from the income and a percentage of the remainder is paid to the direct insurer. In an actual insurance market a loss for the reinsurer for one year is carried forward to the next. This means that no profit commission is paid until a reinsurance loss from previous years has been paid back.

Note: For the sake of simplicity reinsurance losses are carried forward in the Property Insurance Simulation until extinction. In practice reinsurance in most cases losses are carried forward only for a limited period, however: usually three or five years.

Summarizing proportional cash flows

The price for proportional reinsurance is determined by the following factors that are illustrated in the cash flow diagram below:

- Share of the **original premium** (paid by the direct insurer)

- **Reinsurance commission** and other payments (for the benefit of the direct insurer)

- Possibly **profit commission** (for the benefit of the direct insurer)
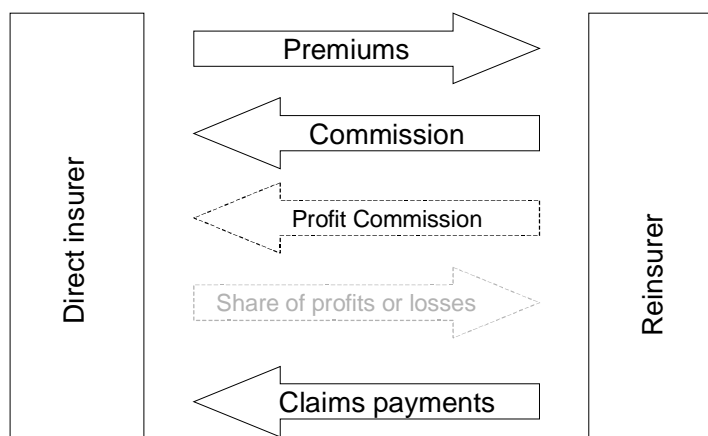
Non-proportional reinsurance

Overview

In proportional reinsurance risks are shared between direct insurer and reinsurer on the basis of sums insured. With non-proportional reinsurance this is not the case.

One way of looking at it is to ignore the individual risks and think of the portfolio as a potential producer of claims. Instead of sharing risks between the direct insurer and reinsurer according to sums insured, **claims are shared**. The liability of the direct insurer is capped at a certain amount. This is called the **deductible**. The reinsurance pays whatever exceeds this amount.

As a result, the conventional summary of non-proportional reinsurance takes the following form:

Maximum claims payment of reinsurer	after	Maximum claims payment of direct insurer
or in other words		
Reinsurance cover	**in excess of**	**Deductible** of direct insurer
For example		
€ 500,000	xs	€ 100,000

In the Property Insurance Simulation the **lower and upper limits** of the excess of loss will be given in order to make things clearer. That is, using the example above: lower limit € 100,000, upper limit € 600,000.

Non-proportional insurance is highly flexible and can be used for portfolios of business with very different risk profiles. For example, the definition of claims can vary. These can be defined as "single loss", "accumulation of losses from one event" or "all claims for a year of account". Non-proportional forms of reinsurance can, secondly, be used at one extreme to cover relatively small, high frequency losses (**working cover**) or at the other it can be used for rare catastrophic events (**sleep easy cover**), and between these two extremes there is a wide range of alternative possibilities.

The different types of non-proportional reinsurance treaties therefore simply use different techniques in defining the claims which are covered by the reinsurer.

To summarize:

- Non-proportional reinsurance is based on **claims sharing**

- The non-proportional reinsurer is only liable for claims above a certain level.

- The non-proportional premium is calculated separately from the original premium.

*If a reinsurance program contains **both** proportional and non-proportional treaties, the risks are shared on a proportional basis first. The part retained by the direct insurer may then be reinsured on a non-proportional basis.*

In other words, non-proportional reinsurance is usually constructed within the framework of proportional reinsurance.

Per risk excess of loss

Concept

A per risk excess of loss reinsurance treaty – called a **Risk XL** for short – protects a direct insurer against single losses that exceed its **deductible**. (What we call the **retention** in proportional reinsurance is called the deductible in excess of loss reinsurance). If a loss exceeds the deductible, the reinsurer will pay the amount of the loss that exceeds the deductible up to the treaty limit.
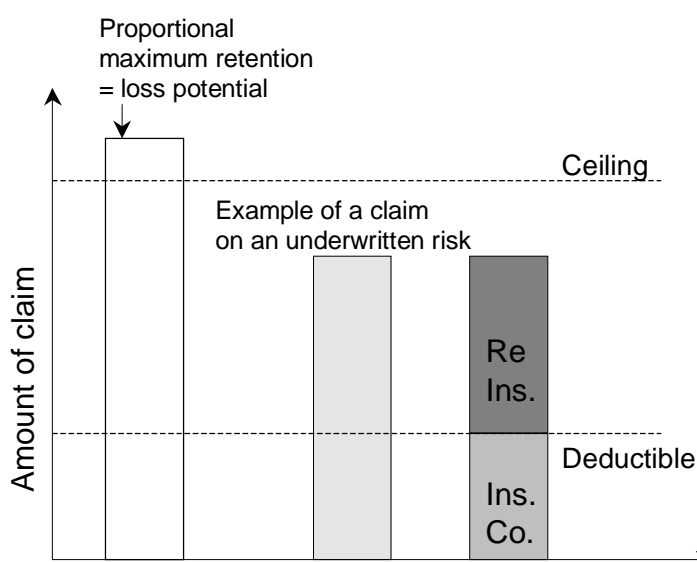
Claims sharing with a Risk Excess of Loss

☐ Example of claim   ▨ Direct insurer   ▮ Reinsurer

Example: In a Risk XL treaty the deductible is € 100,000 and the reinsurance cover is € 900,000. That is, the treaty limit is € 1,000,000.

- *A loss of € 80,000 occurs. The direct insurer pays the claim in full.*

- *A loss of € 150,000 occurs. The direct insurer pays ist deductible € 100,000, and the reinsurer pays the exceeding € 50,000.*

- *A loss of € 1,100,000 occurs. The reinsurer pays ist entire cover € 900,000 and the direct insurer pays the deductible € 100,000 as well as the exceeding € 100,000 above the treaty ceiling.*

Risk XL at a "working" or lower level is quite common in those classes of business where generally only smaller or medium sized claims occur. The reinsurer's liability is on a per loss per risk basis, and it can be capped on an aggregate event basis.

In a similar way to surplus reinsurance the reinsurance **protection** can be **split into** single, smaller units, which are called **layers**. To construct a complete reinsurance cover, the **deductible** of an upper layer must include the capacity of those below it. Depending on the deductible of the individual layers, the lower ones are working covers and the higher ones are (a sort of) accumulation or catastrophe excess of loss covers.

Effects

Let us summarize some characteristics, and some pros and cons from the perspective of a primary insurer:

- Risk XL is suitable for a portfolio of risks that are threatened by high **severity of loss**. That is, it provides good protection against the occurrence of random large losses.

- Risk XL is very effective in reducing the variation in the size of claims for the share of the direct insurer. It caps these losses to the level of the deductible. In this respect a Risk XL is even more effective than a proportional surplus treaty.

- The premium volume ceded to the reinsurer is in general less than in the case of surplus reinsurance, because the direct insurer is not paying for the reinsurer to pay a share of claims it (the direct insurer) could easily pay itself – i.e. claims that are within the deductible.

- Risk XL is simple to administer. A minimum and deposit premium is paid once at the beginning of the year, half yearly or quarterly to the reinsurer for the whole reinsured portfolio of business.

- The calculation of the premium can be difficult. It is likely to vary more greatly from year to year than a proportional reinsurance premium.

- Because the direct insurer pays for 100% of claims that fall within the deductible, it is not protected if the loss frequency of losses lower than the deductible increases.

- It follows from point 2 above that the protection is likely to be inadequate if there is an accumulation of losses due to a **catastrophe**.

You should consider which of your company's business categories – Industrial, Commercial or Domestic -

… is the most likely to be affected by higher than expected severity of loss (random loss).

… is the least likely to be affected by higher than expected frequency of loss (risk of error and risk of change).

Other techniques of non-proportional reinsurance

Accumulation excess of loss, usually called **per event or catastrophe excess of loss (Cat. XL**)	This provides protection if one loss event affects several risks. The reinsurer pays for that part of the accumulated claims that exceed the **deductible**, its liability being capped by the treaty limit.
Stop loss	With a stop loss the reinsurer pays if the direct company's aggregate net losses for a year of account exceed a predetermined amount or a proportion of premium income. In the latter case the loss retention of the direct insured automatically increases, e.g. if it greatly expands ist business.

Stop loss is the most complete form of reinsurance cover, and therefore the one where the **moral hazard** is the greatest from the reinsurer's point of view. For this reason the reinsurer usually requires the direct insurer to participate in losses with a small quota share. |

Pricing non-proportional reinsurance

Overview

In contrast to proportional reinsurance the direct insurer pays a premium to the reinsurer that is calculated independently of the original premium paid by the insureds. This is sometimes the reason for a reinsurer to prefer or even insist on excess of loss reinsurance – if it considers the original premium rates of the direct insurer to be too low, so that it does not want to share its risks on a proportional basis.

The **premium calculation** depends on the type of excess of loss, the claims history and structure of the layer:

- **Burning cost** calculation – based on claims experience. A more sophisticated way of using claims experience is the **extrapolation** which is based on risk theory and modelling the claims profile.

- **Exposure rating** – based on the composition of the portfolio according to sums insured

- **Payback** calculation – based on how many years it would take the maximum probable losses to be „repaid" by future annual premiums.

These quotation methods give the expected value of claims for the layer in question. In what follows, only the burning cost calculation is discussed.

This claims expectation is, however, dependent on the direct insurer's volume of business or on the size of the portfolio. Since the volume of business is usually measured by the premium volume, the price for non proportional reinsurance is:

$$\text{Burning cost rate} = \frac{\text{Layer-claims expectation}}{\text{Protected premium volume}}$$

The **protected premium volume** means the original earned premium for all protected risk categories, i.e. industrial, commercial and domestic business in the Property Insurance Simulation. Usually non-proportional reinsurance protects the proportional retention of an existing proportional reinsurance cover. Thus the protected premium volume is the earned premium volume **after proportional reinsurance**.

Non-proportional reinsurance is concerned with **losses** reaching into the reinsurance **layer**. Since the estimation of the protected premium volume is relatively easy, the core problem is the estimation of the future loss cost for account of the XL-reinsurer. Additionally a non-proportional reinsurance treaty is always based on the final net loss: that is, the claim which the direct insurer actually pays after recovering claims payments from other reinsurance covers. In other words, the net loss is the sum of the original claims **less** the claims payments received from **proportional reinsurance**, if there is any.

Burning cost quotation

A burning cost calculation is based on the **claims experience** of the direct insurer, usually over the last three to five years.

The example that follows illustrates the simplest form of a burning cost calculation:

Example: The quotation is for a risk XL 100.000 xs 50.000 (i.e. lower limit 50,000 and upper limit 15,.000). The following claims data are available. Both the premiums and the claims relate to the retention after proportional reinsurance:

Year	Premiums	Claims	Claims for the layer	Annual claims for the layer	Burning cost
01	1,000,000	30,000	Nil		
		80,000	30,000		
		100,000	50,000	80,000	
02	1,000,000	40,000	Nil		
		200,000	(!)100,000	100,000	
03	1,000,000	60,000	10,000		
		60,000	10,000	20,000	
04	1,000,000	110,000	60,000		
		130,000	80,000	140,000	
05	2,000,000	60,000	10,000		
		80,000	30,000		
		90,000	40,000		
		110,000	60,000		
		130,000	80,000		
		170,000	(!)100,000	320,000	
S	6,000,000			660,000	$\frac{660.000}{6.000.000}=11\%$

Let's summarize the characteristics of the burning cost quotation:

- Given unbiased and relevant data, a relatively good prediction of the claims experience is possible.

- The direct insurer can easily understand the calculation.

- The data allow the reinsurer to understand the business philosophy and the underwriting practice of the direct insurer.

- A trend in loss experience can be built into the premium calculation by weighting the most recent years more heavily.

- A burning cost calculation is misleading if the data is old, incomplete, or if the composition of the portfolio has changed or will change.

- A burning cost calculation results in a nil-premium if there simply happened to occur no layer-claims in the historical data. In such a case the reinsurance underwriter will need to charge for the historically "unburnt" capacity. Other quotation methods are helpful at this end.

Loadings

Each method of quotation for excess of loss - whether burning cost, extrapolation, exposure rating or payback - estimates the loss experience for the layer. In a similar way to which the direct insurance premium is calculated, a **fluctuation or security reserve** is also required, because the loss experience could be worse than what has been calculated.

At the same time, **loadings** for the reinsurer's expenses and profit expectation are required. These loadings are often calculated together "by the seat of one's pants" with a single loading factor. Common factors are 100/80, 100/70, 100/60 etc.

The net **burning cost rate** and the loadings together give the **total XL-rate**, and the premium volume of the direct insurer for the excess of loss cover is multiplied with this rate. The result is the reinsurance premium.

Summarizing non-proportional cash flows

Below you will find the most important cash flows of non-proportional **reinsurance covers**.
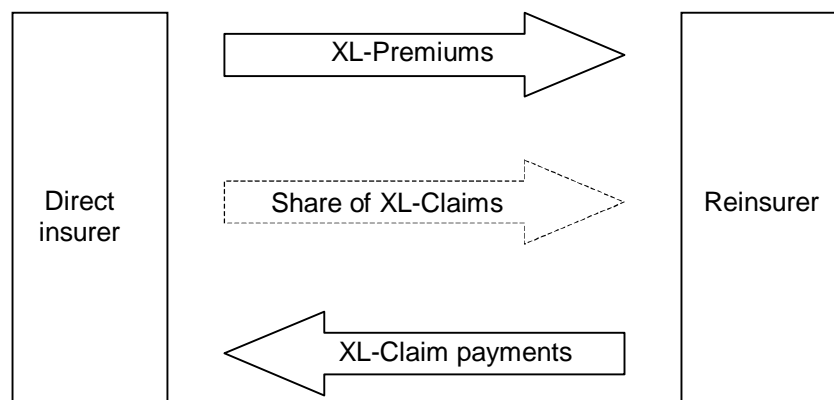
Pricing a risk XL in the P&C Insurance Simulation

In the Property & Casualty Insurance Simulation Game it is possible to cover a portfolio of risks with only one form of reinsurance – either proportional or non-proportional. It is also possible to **combine proportional** and **non-proportional reinsurance**.

If both proportional and non-proportional reinsurance are used for the same book of business, however, remember that non-proportional reinsurance is always linked to the retention of the direct insurer - i.e. the sum insured covered by proportional reinsurance must be subtracted from the total sum insured. This means that the reinsurer must know the premium volume and claims for the proportional reinsurance cover before it can quote for excess of loss.

An example will make this clear (all figures in thousand EURO).

Providing the portfolio data

The most important step is to provide the relevant data which is useful for deciding the outwards reinsurance covers and their prices. Below are the three risk categories of the Simulation with uniform sums insured and different premium volumes and claims for the year 1999:

No.	Risk category	Sum insured. per risk	Earned premium volume	Reported large claims
1	Industrial	2,000	15,000	250;300;550;980
2	Commercial	300	13,000	280;220
3	Domestic	50	12,000	...

Structuring the reinsurance program

Proportional reinsurance: Surplus treaty

After analyzing the underwriting risks implicit in the commercial business, it has been agreed that surplus insurance is a reasonable choice:

Retention of the direct insurer:	150
Reinsurance capacity:	3 lines = 450
Capacity of the surplus:	4 lines = 600

The reinsurance capacity is calculated on a per risk basis:

No.	Risk category	Sum insured.	Surplus line	Reinsurance capacity
1	Industrial	2,000	150	450
2	Commercial	300	150	150
3	Domestic	50	150	none

In the next step it is necessary to figure out the liability ratios of the reinsured depending on the three risk categories:

- **Domestic risks** are retained for 100% by the direct insurer.

- For the **Commercial** category the sharing of risks is on the following proportional basis:

$$\text{R/I-Share} = \frac{\text{R/I-Liability}}{\text{Sum insured}} = 150 / 300 = 50\%$$

  The share of the direct insurer is, therefore, 50%.

- Surplus reinsurance is also used for the **Industrial** category of business. Risks are shared on the following basis:

$$\text{R/I-Share} = \frac{\text{R/I-Liability}}{\text{Sum insured}} = 450 / 2,000 = 22,5\%$$

  The share of the direct insurer is, therefore, 77,5%.

Non-proportional reinsurance: Risk excess of loss

In addition to the proportional reinsurance agreement which is motivated by the commercial business, the direct insurer still feels uncomfortable with respect to large losses. Because of possible large claims in the industrial category of risks an **excess of loss** 400 xs 100 to protect the retention is taken out on retention, i.e.:

Deductible of the direct insurer:	100 (lower limit)
Reinsurance capacity:	400
Capacity of the excess of loss:	500 (upper limit)

Pricing the excess of loss

The **quotation** for the **excess of loss** is done in two stages. First the **burning cost rate** is calculated and then the loadings are added on.

The calculation of the Burning Cost is also done in two stages. First the claims history is calculated (numerator) and then the premium volume to be protected by the excess of loss is calculated (denominator).

$$Burning\ cost\ rate = \frac{Historical\ layer\text{-}claims}{Protected\ premium\ volume}$$

Calculation of the relevant historical claims share (numerator):

Year / Risk	Loss	Loss share in retention of direct insurer (after surplus)		Claims for layer (400 xs 100)
Year 2009				
Industrial	250	(250 x 77,5% =)	194	56
	300	(300 x 77,5% =)	233	67
	550	(550 x 77,5% =)	427	123
	980	(980 x 77,5% =)	760	(!) 400
Commercial	280	(280 x 77,5% =)	217	63
	220	(220 x 77,5% =)	171	49
Total layer-loss				**758**

Calculation of the premium volume (dominator):
The earned premiums of the direct insurer for all relevant risk categories are reduced accordingly if there is surplus reinsurance. If the treaty already exists, the figures can be taken from the reinsurance accounts of the latest periods.

Year / Risk	Earned premiums	Premium share in retention of direct insurer (after surplus)	
Year 2009			
Industrial	15,000	(15,000 x 55% =)	8,250
Commercial	13,000	(13,000 x 50% =)	6,500
Domestic	12,000	(12,000 x 100% =)	12,000
Protected premium volume (all categories)			**26,750**

Note: To improve the accuracy of the calculation, several years' figures should be used, losses and premiums spanning the same period of time.

The **burning cost rate**, which is reflecting the **net premium rate**, is calculated from the relation of the claims for the layer to the premium volume:

In the example: $\frac{758}{26.750} = 2,83\ \%$

To calculate the final rate, **loadings** are added. For example, the two parties direct insurer and reinsurer decide a total XL-premium rate of e.g. 3% or 3,5% or...
Agreeing the loadings as well as any adjustments that may be made to the calculated claims is a **matter of negotiation**.

References

Barile, Andrew: A Practical Guide to Financial Reinsurance, New York 1991

Carter, Robert L.: Reinsurance, 3rd edition, Bath/Avon 1995

Gerathewohl, Klaus: Reinsurance: Fundamentals and Practice, Volume I, Karlsruhe 1976

Gerathewohl, Klaus: Reinsurance: Fundamentals and Practice, Volume II, Karlsruhe 1979

Helten, Elmar: Vom Nutzen der Rückversicherung aus der Sicht der Erstversicherung, in: Eisen und Stahl Rückversicherungs-AG und Hannover Rückversicherungs-AG (Hrsg.): Rückversicherung: Anspruch und Selbstverständnis, Karlsruhe 1984, S. 53-68

Kiln, Robert: Reinsurance in Practice, 3. Auflage, London 1991

Liebwein, Peter: Klassische und moderne Formen der Rückversicherung, 2nd edition, Karlsruhe 2009

Monti, George R. und Barile, Andrew: A Practical Guide to Finite Risk Insurance and Reinsurance, New York 1994

Schenk, Peter: Rückversicherungsentscheidungen von Schaden- und Unfallversicherungsunternehmen, in: Versicherungswirtschaft 1997, S. 363-369

Swiss Re: Reinsurance matters: A practical guide to nonlife insurance, Zurich 2006

Swiss Re: Sigma 7/1992

Swiss Re: Sigma 5/1997

Index

S

Schenk 11
security reserve 29
services 10, 12
severity of loss 5, 25
sleep easy cover 22
Solvency margin 12
Stop loss 26
Surplus 17, 32
system of risk transfer 4

T

target capital 7
Three pillars 7

U

underwriting capacity 12, 18
Underwriting capacity 11
underwriting risks 5, 7, 12

W

working cover 22