



Property & Casualty Simulation Game

Reinsurance

IRIS Insurance® Game

Peter Liebwein
Keith Purvis

© riva
2000-2005
Version 2.1E

Contents

Reinsurance Basics	2
What is Reinsurance?	2
Why Do Insurance Companies Need Reinsurance?	2
Using Reinsurance to Control the Underwriting Risk	2
Using Reinsurance to Extend the Use of Own Capital	5
Using Reinsurance to Finance New Business.....	6
Using Reinsurance Services to Improve Your Business	6
How Does the Insurance and Reinsurance Market Operate?	7
Creating Risk Transfer-Networks.....	7
Observing Reinsurance Market-Cycles	8
What Aspects are Interesting when Arranging a Reinsurance Program?	9
If You Are <i>Purchasing Reinsurance</i>	9
If You Are <i>Selling Reinsurance</i>	9
Proportional Reinsurance	11
Overview	11
Quota Share.....	12
Concept.....	12
Pros and Cons	12
Surplus Treaty.....	14
Concept.....	14
Pros and Cons	15
Pricing Proportional Reinsurance	17
Share of the Original Premium.....	17
Reinsurance Commission.....	17
Profit Comission.....	18
Summarizing Proportional Cash Flows.....	18
Non-Proportional Reinsurance	19
Overview	19
Risk Excess of Loss.....	21
Concept.....	21
Pros and Cons	22
Other Techniques of Non-Proportional Reinsurance.....	23
Pricing Non-Proportional Reinsurance	24
Overview	24
Burning Cost Quotation.....	25
Pros and Cons of the Burning Cost Quotation.....	25
Loadings.....	26
Summarizing Non-Proportional Cash Flows.....	26
Reinsurance for Advanced Learners	27

Financial Reinsurance	27
Alternative Risk Transfer.....	27
Pricing an Excess of Loss in the Simulation	28
Providing the Portfolio Data	28
Constructing the Reinsurance Programme.....	29
Proportional Reinsurance: Surplus Treaty	29
Non-Proportional Reinsurance: Risk Excess of Loss	29
Pricing the Excess of Loss.....	30
Index	31

Reinsurance Basics

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 insurer** or **cedant**, 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 practise them in the Property & Casualty 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 became bankrupt, the insurance company would still be liable to its policyholders to pay all legitimate claims in full. For this reason security is a very important issue for an insurance company in its choice of reinsurers. Bear this in mind when you purchase reinsurance for your company.

Why Do Insurance Companies Need Reinsurance?

Using Reinsurance to Control the Underwriting Risk

When an insurance company calculates its pure 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 pure premium will then be loaded with various safety and profit margins and expense loadings. The property and 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 unfavourable 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 at the underwriting stage.

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 frequency of loss at the same time.

(2) **Risk of Change**

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. 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 (confer US liability sentences) or structural changes in the market (confer environmental liability laws).

(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.

See for yourself the financial cost to the insurance industry of the most expensive insurance losses from 1970 to 2003:

Insured loss ¹⁸ (in USD m, indexed to 2003)	Victims ¹⁹	Date (start)	Event	Country
21 062	3 025	11.09.2001	Terrorist attack on WTC, Pentagon and other	US
20 900	43	23.08.1992	Hurricane Andrew	US, Bahamas
17 312	60	17.01.1994	Northridge earthquake	US
7 598	51	27.09.1991	Typhoon Mireille	Japan
6 441	95	25.01.1990	Winterstorm Daria	France, UK et al
6 382	110	25.12.1999	Winterstorm Lothar over Western Europe	France, CH et al
6 203	71	15.09.1989	Hurricane Hugo	Puerto Rico, US et al
4 839	22	15.10.1987	Storm and floods in Europe	France, UK et al
4 476	64	25.02.1990	Winterstorm Vivian	Western / Central Europe
4 445	26	22.09.1999	Typhoon Bart hits south of the country	Japan
3 969	600	20.09.1998	Hurricane Georges	US, Caribbean
3 261	33	05.06.2001	Tropical Storm Allison; torrential rains; heavy flooding	US
3 205	45	02.05.2003	Thunderstorms, tornadoes, hail	US
3 100	167	06.07.1988	Explosion on platform Piper Alpha	UK, North Sea
2 973	6 425	17.01.1995	Great Hanshin earthquake in Kobe	Japan
2 641	45	27.12.1999	Winterstorm Martin	France, Spain, CH
2 597	70	10.09.1999	Hurricane Floyd; heavy downpours, flooding	US, Bahamas
2 548	38	06.08.2002	Severe floods across Europe	Europe
2 526	59	01.10.1995	Hurricane Opal	US, Mexico
2 288	26	20.10.1991	Forest fires which spread to urban areas, drought	US
2 277	-	06.04.2001	Hail, floods and tornadoes	US
2 220	246	10.03.1993	Blizzard, tornadoes	US, Mexico, Canada
2 090	4	11.09.1992	Hurricane Iniki	US, North Pacific Ocean
1 959	23	23.10.1989	Explosion in a petrochemical plant	US
1 899	-	29.08.1979	Hurricane Frederic	US
1 870	39	05.09.1996	Hurricane Fran	US
1 859	2 000	18.09.1974	Tropical Cyclone Fifi	Honduras
1 827	100	04.07.1997	Floods after heavy rain in Central Europe	Poland, Czech Rep., D et al
1 804	116	03.09.1995	Hurricane Luis	Caribbean Sea
1 707	6	27.04.2002	Spring storm with several tornadoes	US
1 694	350	10.09.1988	Hurricane Gilbert	Jamaica et al
1 685	30	18.09.2003	Hurricane Isabel with winds of up to 170 km/h	US, Canada
1 651	20	03.12.1999	Winterstorm Anatol	West / Northern Europe
1 634	54	03.05.1999	Series of more than 70 tornadoes in the Midwest	US
1 619	500	17.12.1983	Blizzards, cold wave	US, Canada, Mexico
1 605	-	04.04.2003	Thunderstorms with large hailstones	US
1 600	350	02.04.1974	Tornadoes in 14 states	US
1 527	-	25.04.1973	Flooding on the Mississippi	US
1 512	-	15.05.1998	Wind, hail and tornadoes (MN, IA)	US
1 479	63	17.10.1989	Loma Prieta earthquake	US

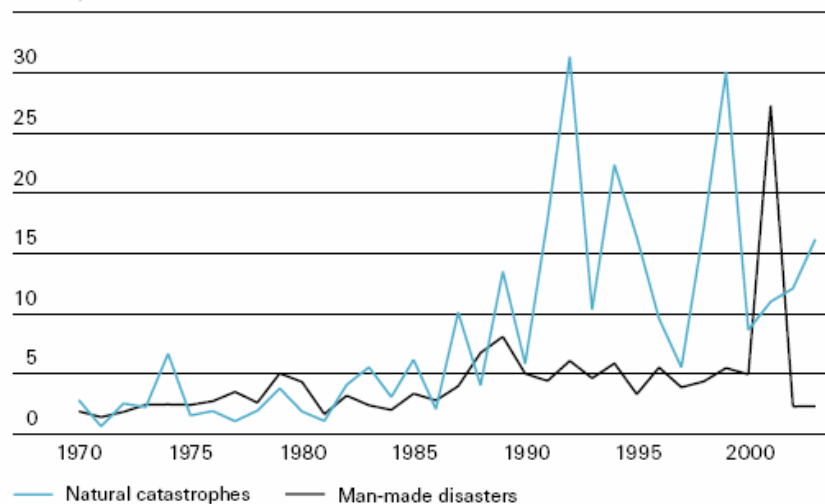
¹⁸ Property and business interruption losses, excluding life and liability insurance losses

¹⁹ Dead and missing

A well thought out reinsurance programme reduces the **fluctuations** in severity and frequency of loss events, and this in turn stabilizes financial results, relieving the Profit and Loss Account, protecting the Balance Sheet and reducing the risk of ruin.

Insured losses 1970-2003:

USD bn, indexed to 2003



(Source: Sigma 01-2004, Swiss Re)

Controlling the **underwriting risk** is the most important service that reinsurers provide to the insurance market, which is why it has been mentioned first. There are also other important ones, however, and these follow below.

Using Reinsurance to Extend the Use of Own Capital

The **Insurance Supervisory Authorities** (ISAs) of most countries are concerned about the financial integrity of insurance companies operating in their territories. For most ISAs the ratio of capitalization to premium income for an insurance company's own account is a crucial measure of financial viability. This ratio is called the **solvency margin**. On average over most European countries, the minimum requirement is – roughly speaking – that an insurance company's capital amounts to **twenty percent** of its retained premium income. In other words, the premiums it retains for own account cannot be more than five times its capital. The solvency margin requirement makes it difficult for a company to expand without raising a great deal of capital. This is where reinsurance comes into play.



An insurance company that wants to expand its business without raising more capital reinsures more of its business than it would otherwise have done. In this way the premium for own account decreases as a percentage of total premium written.

It can now maintain the solvency margin and at the same time increase its market share of new business. If even more reinsurance is bought for the same volume of business written, the insurance company can even maintain the solvency margin with less capital. In both cases the insurance company is effectively using its reinsurer's capital to increase its underwriting capacity.

In the Property & Casualty Simulation you, too, can make use of reinsurance in this way.

Example: A direct insurer has own capital € 2,000,000. The solvency margin is 20%. Without reinsurance it could only write a premium volume of € 10,000,000. Giving its reinsurers a 90% quota of its business, it can expand its business to € 100,000,000, however.

	Without reinsurance.	With reinsurance
Own Capital (equity + profit reserves)	2,000,000	2,000,000
Total earned premium	10,000,000	100,000,000
Earned premium for own account	10,000,000	10,000,000
Solvency margin	20%	20%

Using Reinsurance to Finance New Business

An insurance company may not only use its reinsurer's capital indirectly to increase underwriting capacity, but there may be an actual cash flow from reinsurer to direct insurer. This is achieved by the reinsurer paying a higher commission than the direct insurer's actual costs for acquiring and administering the business ceded. Such arrangements are actually more common in life reinsurance where the long term nature of the business relationship provides an appropriate framework for the amortization of the **financing**. Financing agreements can also be found in property and casualty business, however, especially for newer dynamic companies that want to expand their business quickly.

Using Reinsurance Services to Improve Your Business

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. Reinsurers are constantly extending their range of services in the face of new challenges from the markets.

- (1) Giving advice about and supporting the construction of the portfolio of business, the formulation of the underwriting policy and the reinsurance programme
- (2) New product development and the communication of knowledge about different types of policy gained from other insurance markets
- (3) Profit testing of reinsured portfolios as well as new policy types
- (4) Analyzing and underwriting especially difficult or unusual risks
- (5) Giving advice and co-operating in the investigation, prevention and settling of claims
- (6) Training the staff not only of ceding companies, but sometimes also of potential customers
- (7) 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
- (8) Giving advice on the use of EDP systems and the development of expert systems

Two features of reinsurance **services** are worthy of note. They are often given not only to cedants but also to potential reinsurance customers. That is, they are sometimes a prerequisite to obtaining business. Secondly, the need for them changes over time.

How Does the Insurance and Reinsurance Market Operate?

Creating 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 reinsure 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 **atomization**.

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 **atomization** begins with reinsurance and is continued with **retrocession**.

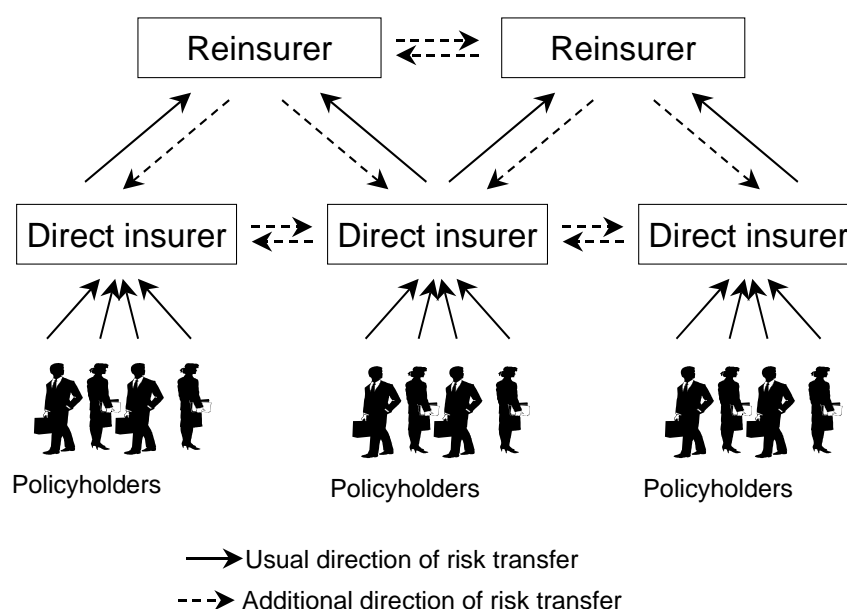


Figure 1: atomization

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.

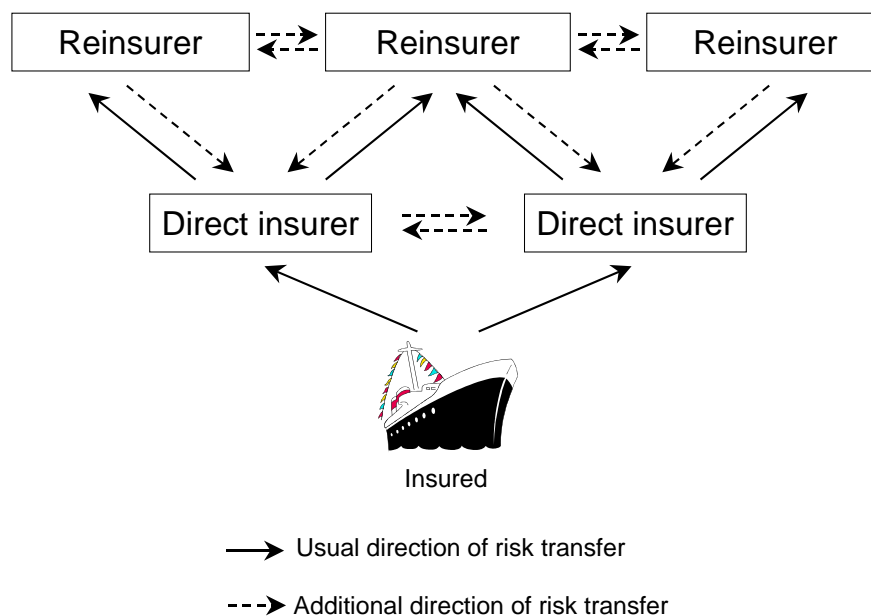


Figure 2: co-insurance

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.

Observing Reinsurance Market-Cycles

What does this mean for those companies writing inwards reinsurance? The market for property and casualty reinsurance is extremely elastic. When reinsurance capacity is scarce, reinsurance premiums rise; direct companies 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. The price cycle functions with ruthless economic logic again and again, mainly because reinsurance markets are narrow (there is a small number of players) and consequently transparent.

What Aspects are Interesting when Arranging a Reinsurance Program?

Depending on the aims of reinsurance buyers or sellers and depending on dealing with inwards or outwards reinsurance, there are different key factors that should be taken into account when reinsurance programmes are established:

If You Are *Purchasing Reinsurance*...

- (1) 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.
- (2) 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 margin** requirements, you should consider proportional reinsurance.
- (3) Thirdly, observe the **market cycle**. If premium rates are high, buy less reinsurance. If they are low, you can buy more. If they are rising or falling, you may choose not to change your program.
- (4) Finally, what **services** do you want your reinsurer to give you?

If You Are *Selling Reinsurance*...

- (1) First analyze the **underwriting risks** in the direct insurer's portfolio depending on which risk category it is.
- (2) Examine the **premium volume and claims experience** of the portfolio over the last three to five years of business.
- (3) Observe the **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 rates to rise.
- (4) Think carefully about the effect on your **own capitalization** if your direct insurer partner wants to buy a large amount of reinsurance to improve its solvency margin.
- (5) Reinsurers that accept more reinsurance from a risk category than they want to keep for their own account arrange for **retrocession** beforehand.
Note: Due to the market in the Property & Casualty Simulation, retrocession is not possible.

- (6) 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 Simulation there is a chance to prove the English sayings which seem to be true for most of the 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” on 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.

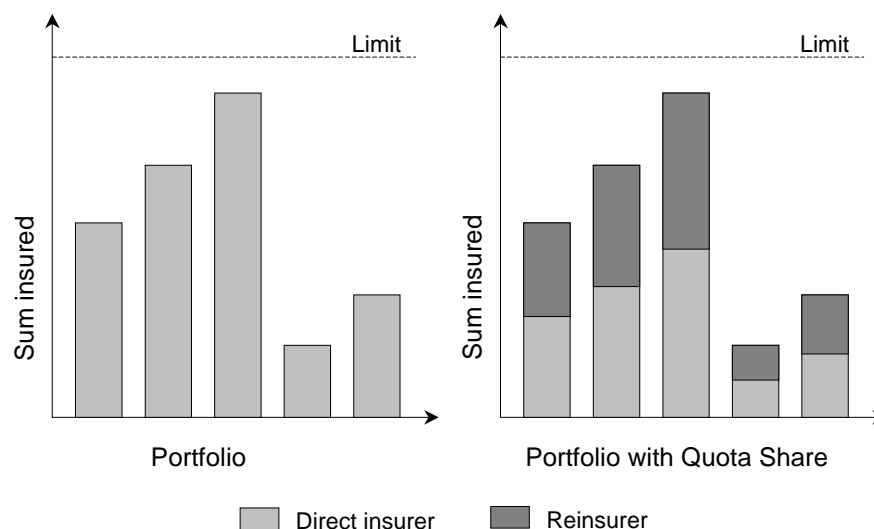
To summarize:

- 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%).

Pros and Cons

Advantages for the Direct Insurer

- (1) 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**).

- (2) 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.
- (3) Quota Share reduces the liability of the direct insurer in **absolute** terms.
- (4) 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).
- (5) 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.
- (6) 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.

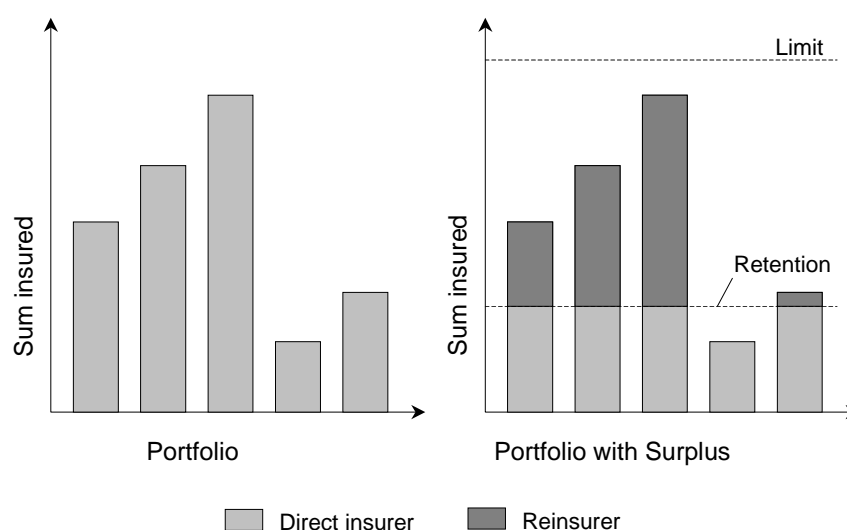
Disadvantages for the Direct Insurer

- (1) 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.
- (2) 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.



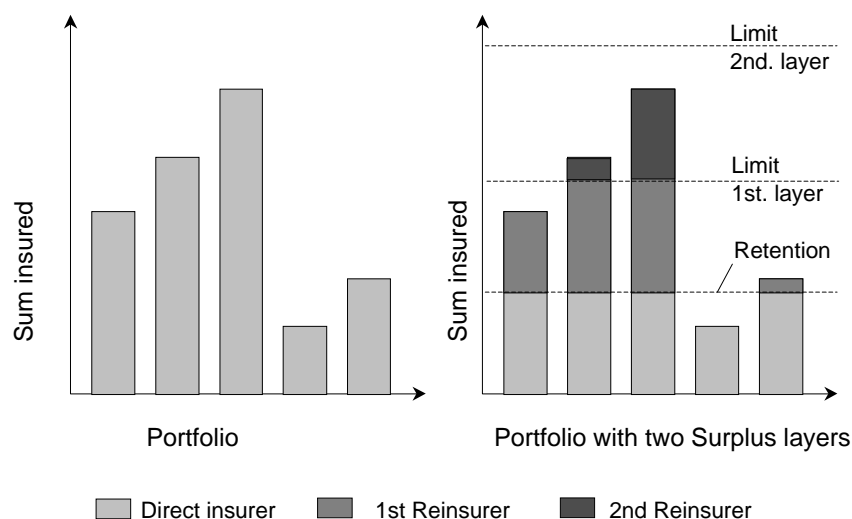
In the case of the surplus the reinsurer's liability is limited by an agreed **number of lines**, which are multiplications of the retention.

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.

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 cedant 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.

Pros and Cons

Advantages for the Direct Insurer

- (1) 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.
- (2) 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.
- (3) 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.
- (4) The surplus can increase the direct insurer's **underwriting capacity**, though it is not as effective as the quota share in this respect.

Disadvantages for the Direct Insurer

- (1) 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.
- (2) 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.
- (3) 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.
- (4) 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.



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

... is most likely to be at risk from severity of loss.

... is also, though to a lesser extent, likely to be at risk from too high frequency of loss.

... is most likely to have a wide distribution of sums insured (risk profile) that could sensibly be reinsured with a 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. The reinsurer pays enough commission to cover the **costs** incurred by the direct insurer in acquiring and administering the business ceded. The rate of commission granted may be adjusted to reflect the expected loss ratio of the business. In addition, the reinsurer sometimes provides a profit commission at the end of the treaty year.

In some markets reinsurance commission simply serves to determine the **price** of reinsurance and has little to do with the direct insurer's actual costs. In such a situation the reinsurer should nevertheless know what those costs are, because if the reinsurance commission is much higher, the direct insurer may be able to make an underwriting profit on the business for the year when the reinsurer has made a loss. In such a situation the direct insurer may well lack the motivation to control the business properly. Instead of viewing its role as a risk carrier, it may act like a broker, especially if the retention is low. Consequently, it is important to maintain the principle of **"follow the fortunes"** in a proportional reinsurance arrangement. A reinsurer will, however, be willing to pay higher commission than the direct insurer's acquisition and administration costs if it approves of its underwriting philosophy and the portfolio of business to be covered has good claims experience.



Take the cost ratios of the direct insured as an orientation for the height of the reinsurance commission. Nevertheless loss ratios, original premium rates, fluctuations of losses are also important factors which take effect on the reinsurance commission. Also take reinsurance market-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 there is any, on the business ceded. It is paid at the end of the treaty year to reward the direct insurer for good business. For this reason it is sometimes called an „Experience Refund“

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)
	<i>Reinsurers' expenses</i>
	<i>Reinsurance losses carried forward</i>

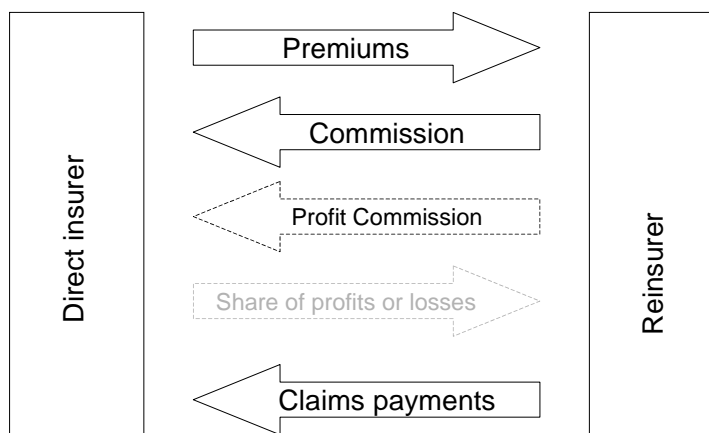
The outgo is subtracted from the income and a percentage of the remainder is paid to the direct insurer. In an actual insurance market a loss for the reinsurer for one year is carried forward to the next. This means that no profit commission is paid until a reinsurance loss from previous years has been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

Note: For the sake of simplicity reinsurance losses are carried forward in the Property & Casualty 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
Reinsurance cover	<i>or in other words</i> in excess of	Deductible of direct insurer
	<i>For example</i> xs	
€ 500,000		€ 100,000

In the Property & Casualty 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.



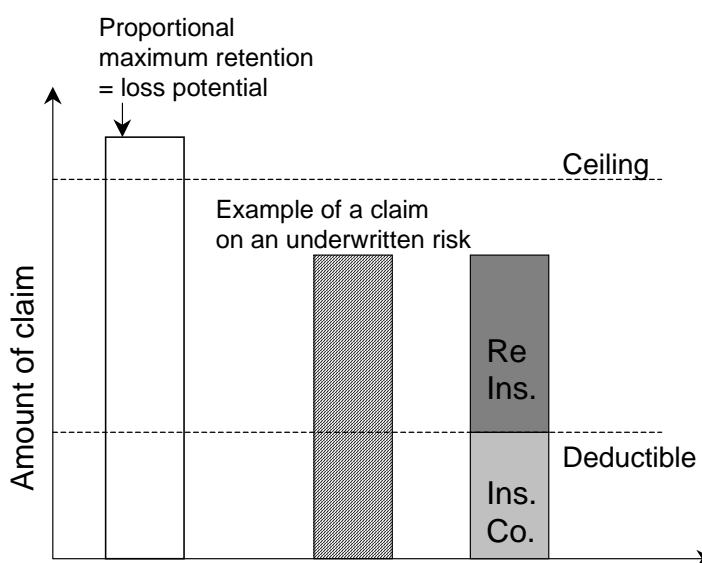
*If a reinsurance programme contains **both** proportional and non-proportional treaties, the risks are shared on a proportional basis first. The part retained by the direct insurer may then be reinsured on a non-proportional basis.*

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

Risk Excess of Loss

Concept

A 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 its deductible € 100,000, and the reinsurer pays the exceeding € 50,000.
- A loss of € 1,100,000 occurs. The reinsurer pays its 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.

Pros and Cons

Advantages for the Direct Insurer

- (1) 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.
- (2) 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.
- (3) 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.
- (4) 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.

Disadvantages for the Direct Insurer

- (1) The calculation of the premium can be difficult. It is likely to vary more greatly from year to year than a proportional reinsurance premium.
- (2) 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.
- (3) 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

<p>Accumulation Excess of Loss, usually called Catastrophe Excess of Loss (Cat. XL)</p>	<p>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.</p>
<p>Stop Loss</p>	<p>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 its business.</p> <p>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.</p>

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 & Casualty 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 150,000). 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	
Σ	6,000,000			660,000	$\frac{660.000}{6.000.000} = 11\%$

Pros and Cons of the Burning Cost Quotation

Advantages of the Burning Cost Quotation

- (1) Given unbiased and relevant data, a relatively good prediction of the claims experience is possible.
- (2) The direct insurer can easily understand the calculation.
- (3) The data allow the reinsurer to understand the business philosophy and the underwriting practice of the direct insurer.
- (4) A trend in loss experience can be built into the premium calculation by weighting the most recent years more heavily.

Possible Difficulties with Burning Cost Quotation

- (1) A burning cost calculation comes to a misleading result if the data are old or incomplete or if the composition of the portfolio has changed or will change significantly.
- (2) 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

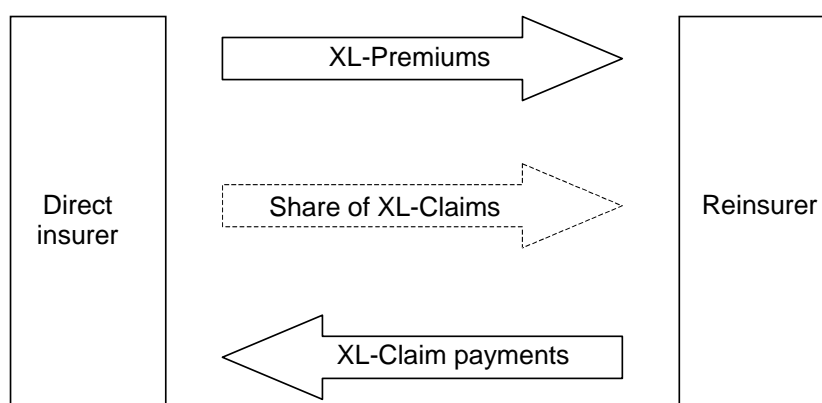
Each method of quotation for excess of loss - whether burning cost, extrapolation, exposure rating or payback - estimates the loss experience for the layer. In a similar way to which the direct insurance premium is calculated, a **fluctuation or security reserve** is also required, because the loss experience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



Reinsurance for Advanced Learners

Financial Reinsurance

When the *raison d'être* of a reinsurance arrangement is not to protect a direct insurer from the underwriting risks associated with higher than expected severity and frequency of loss, it can no longer be classified as a traditional reinsurance agreement. What, then, is its purpose?

The reason for concluding such types of agreement may be to circumvent tax regulations or insurance supervisory requirements by, for example, minimizing the tax burden or releasing loss reserves. These types of reinsurance were developed in the USA in the 1970s and they are usually designed to have a beneficial optical effect on the balance sheet or increase liquidity. They are collectively called **Financial Reinsurance** or **Finite Risk Reinsurance**. They often function by arbitrage: the reinsurer is taxed or controlled more lightly in another country from the direct insurer and the reinsurance treaty is constructed in such a way that the direct insurer can make use of this fact.

Tax, supervisory and other authorities, whose regulations are being side-stepped are understandably suspicious of such arrangements that can constitute a misuse of reinsurance. In the worst case the parties to such agreements profit at the expense of taxpayers and the security of policyholders. Financial reinsurance does have a constructive role to play, however, in structuring certain types of claims payments, and in such cases, these arrangements gain official approval.

Alternative Risk Transfer

Since the beginning of the 1990s additional reinsurance cover has been generated outside the traditional reinsurance market.

Instead of insurance companies and professional reinsurers providing capacity, investors on the capital market are encouraged to act as secondary risk carriers for direct insurance companies. Reinsurance companies also try to use this source of capacity as an alternative retrocession market, especially for catastrophe risks for which worldwide capacity sometimes is inadequate..

Risks are frequently linked to financial instruments such as **bonds** or **derivatives**. In this way risk transfer from the insurance or reinsurance company to the capital market is achieved.

This type of reinsurance that uses forms of reinsurance different from the traditional kinds is generally known as "**Alternative Risk Transfer**".

Pricing an Excess of Loss in the Simulation

In the Property & Casualty 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	1,000	15,000	250;300;550;980
2	Commercial	300	13,000	280;220
3	Domestic	50	12,000	...

Constructing the Reinsurance Programme

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	1,000	150	Nil
2	Commercial	300	150	150
3	Domestic	50	150	450

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:

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

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:

$$R/I\text{-Share} = \frac{R/I\text{-Liability}}{\text{Sum insured}} = 450 / 1,000 = 45\%$$

The share of the direct insurer is, therefore, 55%.

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).

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

Calculation of the relevant historical claims share (numerator):

Year / Risk	Loss	Loss share in retention of direct insurer (after surplus)	Claims for layer (400 x 100)
Year 1999			
Industrial	250	(250 x 55% =) 138	38
	300	(300 x 55% =) 165	65
	550	(550 x 55% =) 303	203
	980	(980 x 55% =) 539	(!) 400
Commercial	280	(280 x 50% =) 140	40
	220	(222 x 50% =) 110	10
Total layer-loss			755

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 1999		
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: $\frac{755}{26.750} = 2,82\%$

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**.

Index

A

absolute 13, 15
 accumulation 3, 13
 administration 13, 16
 Alternative Risk Transfer 27
 atomization 7
 attrition losses 12

B

burning cost 26
 Burning Cost 24, 25, 30

C

Cash flows 26
 catastrophe 9, 16, 22
 Catastrophe Excess of Loss 23
 cedant 2
 claims experience 25
 claims sharing 19, 20
 coinsurance 7
 costs 17

D

deductible 19, 21, 22, 23
 definition of reinsurance 2
 derivatives 27
 direct insurer 2

E

Excess of loss 30
 Excess of Loss 21
 Exposure Rating 24
 Extrapolations calculation 24

F

Financial Reinsurance 27
 financing 6
 Finite Reinsurance 27
 fluctuations 4
 follow the fortunes 13, 16, 17
 frequency 2, 4

I

in excess of 19
 Insurance Supervisory Authorities 5

L

large losses 22
 Layer 22
 Limits 19

lines 14
 loading 26
 loadings 30
 loss expectation 24
 losses carried forward 18

M

market cycle 9
 moral hazard 13, 23

N

non-proportional reinsurance 19, 28

O

original premium 17, 18
 outwards reinsurance 7

P

Payback calculation 24
 premium calculation 24
 price 17
 pricing 17, 24
 profit commission 18
 profit sharing 18
 proportional reinsurance 11, 28

Q

Quota Share 12
 quotation 30

R

random loss 13
 rate 26
 reinsurance capacity 16
 reinsurance commission 16, 17
 reinsurance cover 9, 19, 26
 reinsurance market 8
 reinsurance programme 9
 retention 9, 12, 14, 16, 21, 24
 retrocede 7
 retrocession 7, 9
 retrocessionaires 7
 risk of change 3, 9, 12
 risk of error 3, 12, 15
 risk of random loss 3, 9, 15
 Risk XL 21

S

security reserve 26
 services 6, 9
 severity of loss 2, 22
 sleep easy cover 19
 Solvency margin 5, 9
 Stop Loss 23
 Surplus 14, 30

system of risk transfer 8

T

twenty percent 5

U

underwriting capacity 9, 15

underwriting risks 2, 5, 9

W

working cover 19