



International Actuarial Association  
Association Actuarielle Internationale

# IAA Risk Book Reinsurance

Insurance Regulation  
Committee

May 2023





# **IAA Risk Book Reinsurance**

**This Risk Book chapter has been developed and approved  
by the Insurance Regulation Committee of the IAA**

1203-99 Metcalfe, Ottawa ON K1P 6L7 Canada

[www.actuaries.org](http://www.actuaries.org)

**Tel:** +1-613-236-0886

**Email:** [secretariat@actuaries.org](mailto:secretariat@actuaries.org)



## Comment and feedback

Comment and feedback on Risk Book chapters is welcomed.

To provide comments on chapters of the Risk Book or to report any problems with the website, please send an email to [riskbookcomments@actuaries.org](mailto:riskbookcomments@actuaries.org).

## Version

Number	Date Approved	Author(s)	IAA Reviewer(s)
1.0	August 2015	Reinsurance Subcommittee of the Insurance Regulation Committee <i>(Intra-Group Reinsurance Transactions chapter)</i>	
1.0	September 2015	Michael Eves, Alexander Fritsch, Eberhard Müller <i>(Non-proportional Reinsurance chapter)</i>	
2.0	May 2023	Michael Eves <i>(Combined and replaced the earlier chapters)</i>	

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## Introducing the IAA Risk Book

The actuarial profession has contributed significantly to the development of risk management tools and processes, in insurance, pensions and related industries. Actuarial skills are also increasingly being applied in new and developing areas of knowledge.

Actuarial practice continues to improve the understanding, measurement and communication of risk and risk events and their implications through the development of tools and increasingly processes to manage the future uncertainty of risks in a sustainable and transparent way. These tools and processes trace, manage and mitigate the acceptance and transmission of the uncertain outcomes of risks.

The Risk Book is intended to provide high-quality reference materials to support a better understanding of the risks and inherently uncertain future outcomes that need to be managed when delivering financial services products – whether they involve insurance, investments or retirement incomes, or more broadly. The Risk Book is written to be accessible to a wide range of readers, many of whom may not be actuaries or experts in the areas discussed but may be decision-makers in those areas. Consequently, the Risk Book should provide insight into the ideas and concepts behind actuarial topics and concepts. It is therefore focused on being descriptive rather than being formal and mathematically precise.

All the Risk Book chapters are publicly available on the IAA website and are periodically updated. See [www.actuaries.org](http://www.actuaries.org) and follow the path to '*Knowledge / Publications / IAA Risk Book*'. A discussion of their structure and relationships is provided in the Chapter: *Introduction – Using the Risk Book*.

The Risk Book is intended to be a dynamic and evolving resource, updated over time, reflecting new areas where actuarial expertise can add value, experience and advances, and topics of current interest and importance. It is electronically distributed to support ongoing updates. Risk Book chapters will be reviewed periodically at least every 5 years and more frequently if significant changes or developments occur.

The development and maintenance of the Risk Book is managed by the Risk Book Editorial Board of the IAA Insurance Regulation Committee.

Many people, mostly actuaries, have contributed to the Risk Book. Contributors are listed on the website.

To submit comments or questions about this Risk Book chapter, or to report any problems with the website, please email [riskbookcomments@actuaries.org](mailto:riskbookcomments@actuaries.org). To express interest in becoming involved with the Risk Book please go to the website and provide the requested information.

## **1 Overview**

### **1.1. Background**

Reinsurance is a powerful risk-mitigating tool for insurance undertakings as it allows insurance companies to transfer significant amounts of underwriting risk – be it for single losses or for entire portfolios – to reinsurers at a given price. Reinsurers typically are able to diversify risks worldwide (e.g., for natural catastrophes) and between different lines of business (e.g., property and casualty, or P&C). Reinsurance can be a very efficient form of capital management as it frequently forms the basis for creating significant capital relief for reinsurance buyers. In turn, the credit risk and liquidity risk associated with the outstanding reinsurance may limit the extent to which reinsurance is effective in mitigating risk or providing capital relief.

Proportional reinsurance is the most common form of reinsurance in life and health (L&H) business due to the long-term nature of most of the business. Non-proportional structures are much more common in P&C, thereby transferring peak risks from the balance sheet of the insurer to the balance sheet of the reinsurer. Non-proportional structures for L&H business are growing in use but presently are normally for special one-off situations rather than applied across the industry. Proportional reinsurance also plays a role in P&C business, particularly for capital considerations and the mutual sharing of risks.

### **1.2. Aim of Chapter**

The aim of this chapter is to outline the key features of reinsurance arrangements, how they are priced and their potential impact on both the cedant and reinsurer. The focus is on P&C reinsurance, though L&H reinsurance is covered throughout the chapter at a high level for completeness.

### **1.3. Relevance to Actuaries**

Actuaries often play a key role in establishing reinsurance requirements and reinsurance structures.

### **1.4. Executive Summary**

The key messages include:

1. Reinsurance, especially non-proportional reinsurance, is a very powerful tool in spreading risk and diversifying risk.
2. Non-proportional reinsurance is used extensively in P&C (non-life) reinsurance but is less common for L&H reinsurance, where proportional reinsurance continues to dominate.
3. In addition to risk and capital considerations, non-proportional reinsurance is used extensively to reduce the potential volatility of a company's quarterly or yearly earnings.
4. Proportional reinsurance is mostly geared towards a proportionate sharing of risk between the insurer and their reinsurer(s). There is generally a mutual sharing of risk between the parties, and hence their fortunes are closely linked.

5. The risk assessment and the pricing of reinsurance products are reliant upon having good, meaningful data. This can contribute to the overall improvement of data quality, especially for smaller insurers.
6. As regulatory capital regimes become more risk-based, it is likely that non-proportional reinsurance solutions will become more common across all lines of business.
7. Reinsurance carries a risk in respect of a failure of, or dispute with, the reinsurer. This risk needs to be carried in measuring the capital requirements of the insurer.

## 2 Introduction

Reinsurance is a powerful risk management tool for insurance undertakings (cedants). It allows an insurer to transfer significant parts of risk to third parties (reinsurers) for a set premium. The main purpose for many cedants is to obtain capital relief, while reinsurers effectively manage capital through worldwide diversification. This is especially true for non-proportional reinsurance, as it allows the cedant to substitute substantial (expensive) amounts of its capital with lower (cheaper) capital of reinsurers as they turn worldwide diversification effects into a capital credit. In this sense reinsurers apply the “principle of insurance” for insurance undertakings in the same way as insurance undertakings provide the “principle of insurance” for their own clients.

Reinsurers often have expertise that an insurer wishes to obtain. Hence in many instances a reinsurer will work closely with an insurer; e.g., on developing new products or providing underwriting or claims support. In return, the insurer rewards the reinsurer by reinsuring part of the portfolio with them. This is more typical for L&H business, and a proportional arrangement allows both the insurer and reinsurer to share the profits or losses arising from their co-operation.

It needs to be noted that by transferring risk to a reinsurer the cedant takes on counterparty credit risk in the event of the failure of the reinsurer. This risk is normally a much lower risk than the claims risk placed with the reinsurer, particularly if the reinsurer is highly rated. Cedants will often try to reduce this risk by placing their reinsurance with several reinsurers, and will normally also maintain counterparty credit limits for individual exposures to a single reinsurer. In addition, there is a dispute risk whereby a reinsurer may challenge the validity of a claim presented by the insurer. One common example relates to natural catastrophe or wildfire losses whereby there can be a dispute over whether the losses are due to one or more events.

In a broader context an insurer must also consider liquidity risk from the fact that it will pay claims to insureds prior to making a recovery from the reinsurer. Often, for large events, there will be a clause in the reinsurance contract for the reinsurer to provide advance payments prior to the complete resolution of a claim.

## 3 Categories of Reinsurance

### 3.1. Facultative vs. Treaty

There are two main types of reinsurance, namely treaty and facultative. Facultative reinsurance is normally underwritten by the reinsurer on a risk-by-risk basis in contrast to treaty business, where the

reinsurer will underwrite a portfolio and agree treaty terms under which the insurer can automatically cede risks to the reinsurer. For non-life business, facultative reinsurance is typically purchased for large single risks like oil platforms or major construction sites for a defined operating or construction period, while treaty reinsurance typically covers entire portfolios (usually for one year). As the processes of assessing and handling risks are quite different, it is common for facultative reinsurance to be managed by dedicated “facultative departments” within professional reinsurers. For life insurance, facultative reinsurance may cover lives with specialized medical conditions or lives seeking very large sums assured. “Treaty reinsurance” is normally organized by geographical regions and/or lines of business.

### **3.2. Proportional vs. Non-proportional**

Proportional reinsurance typically shares the fortunes between cedants and reinsurers in a proportional manner – be it on given single exposures by “layers” (surplus treaties) or for entire portfolios (quota share treaties). A layer, for example, could be 100k excess of 200k whereby losses within the layer between 200k and 300k would be shared in the agreed proportional manner. Premiums and losses are shared by the agreed ratio, adjusted by compensation for cedants for their business generation and administration expenses (reinsurance commission).

Non-proportional reinsurance transfers losses beyond a certain threshold (retention) from cedants to reinsurers, be it for single losses (per risk excess of loss), events (catastrophe excess of loss), entire portfolios over a given period (aggregate excess of loss, stop loss) or a combination thereof.

Prices for reinsurance are agreed upon between cedants and reinsurers. This can be done through direct negotiations or through (reinsurance) brokers. It is usual that information – on current exposures as well as on loss history – will be made available to reinsurers to allow for an assessment of the risk profile of the exposures reinsured.

Different structures of proportional and non-proportional reinsurance are discussed in Section 4 below.

### **3.3. Short-Tail vs. Long-Tail Incurred Claims**

Depending on the nature of the underlying risks there is a distinction between business segments where the ultimate size of losses (e.g., property lines) is known quite quickly and lines where the knowledge about loss occurrences as well as the final determination of loss amounts may not be known until years or even decades after the treaty period (e.g., liability lines).

For non-proportional reinsurance treaties, it is usual for cedants to notify the reinsurer of underlying losses only if they are estimated to exceed the contractual notification level (e.g., half of the attachment point; the attachment point is the amount above which the reinsurer is on risk for its share of a claim). This leaves the burden to reinsurers to estimate the amount of “incurred but not reported” losses (IBNR) for reserving purposes. Deriving this amount and consequently the “ultimate expected loss ratio” is a crucial task of reinsurers. Failing here can lead to future losses, which, if significant, will impact future earnings and solvency. Consequently, there is a considerable capital charge for uncertainty in respect of the reserve estimates that create much income volatility over time. An approach that can be used to reduce this uncertainty is to agree on “claims made” rather than “loss occurrence” policies, as “claims made” means that only claims notified in the given period are covered while “loss occurrence” policies cover losses when they occur – even if they only become known at a time far in the future. This can

also be used on the primary insurance level or – independent from the primary structure – for the reinsurance treaty only.

An example that demonstrates this effect is medical malpractice coverage: the cause of a medical condition or injury that requires future treatment may be an action that takes place today (e.g., leaving a sponge in the body after a surgery). Symptoms may become evident 10 years from now, triggering a first treatment. This treatment may turn out to be ineffective over an additional 10 years and may then trigger a legal case. This legal case then may take another decade until the final settlement. The time from the action that caused the problem to the final settlement can take 30 years! Therefore, it is helpful for both parties to limit the “notification period” to a given year within a claims-made policy and to provide “prior acts” coverage – if necessary – at separately calculated prices. The exact reinsurance structure will depend on the underlying insurance policies as the insurer will wish to avoid having any gaps in exposure in its reinsurance protection.

### **3.4. Direct vs. Brokered**

Sometimes reinsurance is differentiated between direct business (i.e., a business relation between cedant and reinsurer without an intermediary) and brokered business. Brokered business is much more common for P&C business compared to L&H business, where brokers are seldom involved. For brokered business, usually the broker provides all the services surrounding a treaty, such as supplying the data for risk assessments, comparing the offers, setting the terms, wording the treaties, allocating the shares, collecting and distributing premiums and losses, and trying to assist in solving disputes between the insurer and reinsurer.

The charge for these services from a broker is usually a percentage of the premium. While for proportional treaties with their comparably higher premium volume and lower administration requirements the charge is usually small, it can be quite significant for non-proportional treaties. This charge therefore constitutes a material part of the pricing considerations.

## **4 Types of Proportional/Non-Proportional Reinsurance**

Proportional and non-proportional reinsurance are normally applied to a portfolio or group of risks by means of a reinsurance treaty.

Proportional reinsurance has two major adjustment factors: the sharing ratio and the commission. In other aspects the reinsurer usually “follows the fortune” of the cedant, but this can be subject to the exact treaty terms. For example, a feature frequently seen in proportional L&H treaties are profit participation features that allow cedents to share in favourable experience. In contrast, non-proportional reinsurance allows for tailor-made solutions fitted to the targeted risk profile of cedants as close and as flexible as possible. This applies not only to the technical structure of the treaty (including reinstatements of coverage after loss events for catastrophe covers) but also to the set of conditions surrounding the treaty, including event definitions (e.g., hour clauses for storm events), inclusions/exclusions and cash loss provisions.

#### **4.1. Proportional Reinsurance: Quota Share**

This is a common form of reinsurance in both life and non-life businesses. Quota share reinsurance can be applied to a product, a line of business or an entire portfolio. The percentage quota share determines the exact sharing of risk; e.g., a 20% quota share to a reinsurer means that the reinsurer will pay 20% of the incurred losses covered by the treaty. Non-life business will often have more than one reinsurer participating, with each reinsurer having their respective percentage quota share, whereas L&H business will more frequently have just a single quota share reinsurer. Quota share treaties usually allow for some overriding commission to be paid by the reinsurer which will compensate the direct insurer for its own internal expenses. Excess profit emergence to the reinsurer is frequently limited by using a profit share structure whereby some money is refunded back to the insurer when claims are much lower than expected.

#### **4.2. Proportional Reinsurance: Surplus**

“Surplus reinsurance” is generally a term applied to proportional L&H reinsurance, although in many ways it has similarities to an excess of loss structure as applied to non-life, as described in the next section.

Surplus reinsurance as applied to life business will provide coverage to sums assured over the retention of the insurer; e.g., for life business this could be the excess over 100k sum insured. If the total sum assured on the policy is 200k then the insurer and reinsurer both participate for 50% of this individual risk. (An alternative structure is to reinsure a percentage of a risk above a retention; e.g., reinsure 50% of the risk excess of 100k.) The premium payable to the reinsurer is either on an original terms basis (i.e., following the principles of the quota share described above) or more commonly on a risk premium basis whereby the insurer pays the reinsurer an annual premium based on the age of the underlying policyholder on terms agreed at the inception of the treaty. Incorporating an insurer retention structure into life reinsurance treaties is commonly found in risk premium treaties but is less common in original terms treaties.

#### **4.3. Non-proportional Reinsurance: Excess of Loss**

Excess of loss (XL) reinsurance as applied to non-life business transfers losses beyond a certain threshold (retention) from cedants to reinsurers. This can be done for single losses, events, portfolios or a combination thereof. Losses are covered up to a certain limit. Various limits can be staggered (“layers” of coverage). Cedants may cede all the losses in a layer or retain certain percentages of given layers. Reinsurers may demand that the cedant retain a portion of the layer so that the cedant retains the incentive not to overpay claims once losses reach the ceded layer. Unlimited covers are possible in certain circumstances.

### A. Per Risk XL

Example: Showing retention, limit, and uncovered top for two layers for three losses.

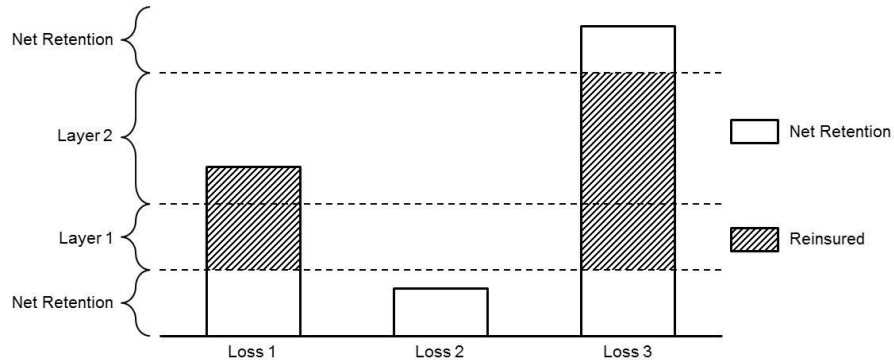


Figure 1: Example per risk XL

### B. Catastrophe XL

Example: Showing retention, limit, and uncovered top for one event.

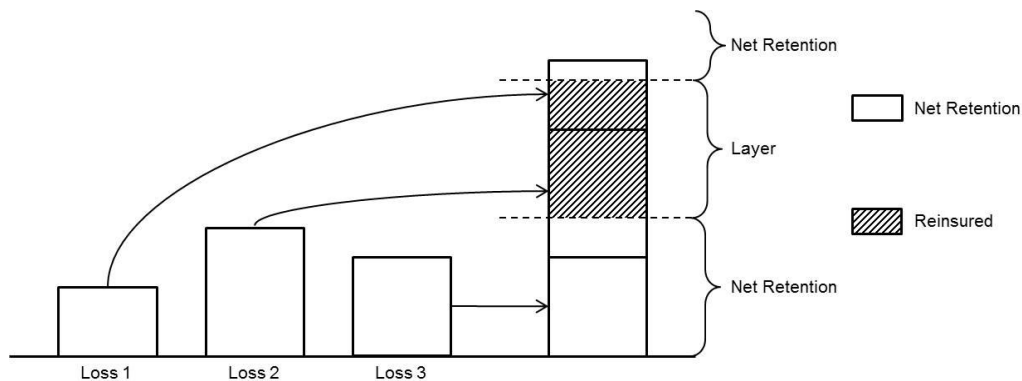


Figure 2: Example catastrophe XL

### C. Aggregate XL, Stop Loss

Regardless of the physical reasons for losses, entire portfolios can be reinsured beyond a certain threshold. For stop-loss treaties, retention and limit are typically expressed in (annual) loss ratio terms for the covered portfolio (example for a stop-loss cover: 20% excess of 110% loss ratio).

## 5 Life Reinsurance vs. Non-life Reinsurance

While in principle the same kinds of non-proportional reinsurance are available for L&H reinsurance, it is currently far more important for non-life reinsurance, especially for natural catastrophes. The most common form of life reinsurance has traditionally been on a proportional basis, although surplus reinsurance, which in some respects is similar to non-proportional reinsurance as defined for P&C business, has also been used. Non-proportional reinsurance for life business is more common on a small group of lives or in respect of a catastrophe event where there is an accumulation of potential risk. An example would be a group life scheme where the cedant is concerned about a single event that

could impact several or many lives within the same group scheme. Other forms include stop-loss reinsurance and coverage for a period of payments in excess of a retained amount – e.g., for disability income or long-term care insurance coverage.

As solvency regimes become more risk-based, cedants will be looking to reinsure their peak (tail) risks that are consuming a lot of capital. For mortality the main threat to solvency is often from a pandemic event, and it is likely that non-proportional reinsurance structures will grow in this area. In recent years the capital markets have developed non-proportional types of covers aimed at protecting certain levels of excess mortality. Mass lapse risk is another area where non-proportional-type reinsurance structures are developing.

## 6 Pricing of Non-proportional Reinsurance

As indicated earlier, the pricing of proportional reinsurance tends to follow the underlying pricing of the cedant, or for certain types of L&H reinsurance applies an annual risk premium charge related to the characteristics of the life being reinsured. The annual risk premiums to be charged per unit of risk for this type of L&H reinsurance would be agreed at treaty inception and would be applied each year to the risk characteristics of the underlying insureds. In contrast, the pricing of non-proportional reinsurance treaties for non-life business is carried out on a portfolio basis without specific reference to the risk profile of each insured risk. The two most common methods used to price are one based on experience and one based on estimated exposures.

### 6.1. Experience-Based Methods

The loss experience for a given layer forms the basis for pricing. The most common method, the “burning cost” method, calculates the proportion of observed “ground up” losses that would have created a loss for the considered layer. Of course, it is essential that the historic losses are transformed into the current treaty period to allow for loss inflation and especially superimposed inflation. The latter relates to loss increases due to trends beyond inflation (e.g., for medical malpractice claims because of the improvement of medical treatment, changes in the legal environment or “social inflation”). Other relevant trends must also be reflected. In some cases, this can result in decreasing historic losses in either number or amount (e.g., the effect of changing regulation or the introduction of effective loss prevention measures like sprinkler devices in respect of property damage claims). On balance, trends generally increase historic losses.

The annualized amount of (updated) losses divided by the annual premium forms the so-called “burning cost” ratio. Expressed as a percentage of the limit, this is the so-called “net” rate on line (ROL). Risk margins (e.g., for using the “cost of capital” method), expense margins and brokerage (for business through brokers) will be added to arrive at the “gross” ROL.

For low “net” ROLs (i.e., for less frequent events), the uncertainty and therefore also the amount of capital bound to back this uncertainty can be significant. The consequence is that for very infrequent events – e.g., return periods of 100 years (1% “net” ROL) – the risk margin may be a multiple of the expected value of losses and therefore the most significant part of the premium.

Example: Consider the following historical losses (fgu = from ground up) as shown in the table below. The contract is a non-proportional reinsurance layer covering individual losses from 1,000 up to 2,000,

normally termed as 1000 xs 1000 (free reinstatements are also assumed – see paragraph later for further discussion of reinstatements).

Year	Incurred Loss (fgu)	Loss to Layer (1000 xs 1000)
2005	1,500	500
2005	1,200	200
2006	2,400	1,000
2008	900	0
2008	600	0
2008	1,100	100
2009	3,500	1,000
2010	1,900	900
2010	1,300	300
2010	1,800	800
2010	900	0
2011	700	0
2013	1,800	800
2013	1,700	700
2014	1,600	600

To calculate the burning cost of that layer, the total losses are divided by the total premium to the layer. The table below shows the annual premium (paid by the policyholders to the cedant) as well as the annual total losses to the layer.

Year	Premium	Losses to Layer
2005	9,500	700
2006	10,000	1,000
2007	10,000	0
2008	11,000	100
2009	10,500	1,000
2010	11,000	2,000
2011	12,000	0
2012	13,000	0
2013	11,500	1,500
2014	12,500	600
Totals	111,000	6,900
Burning Cost	6.22%	

Eventually, a burning cost is derived for the reinsurance premium of 6.22%. Note that this example is simplified to illustrate the basic working of the burning cost calculation. In practice, consideration is given to aspects such as inflation, reinstatement premiums, original rate changes, indexation clauses or trends that are only partly included.

Through various types of profit commission arrangements (i.e., by sharing of part of the profit of a reinsurance treaty with the cedant), a reinsurer can try to provide a further incentive for a cedant to ensure effective underwriting and loss management. As profit commissions transfer at least some parts of the volatility back to the cedant, they may decrease the related risk margin. A similar effect may be achieved if the cedant retains a certain percentage of a ceded layer for its own account.

## 6.2. Exposure-Based Methods

For treaties with insufficient loss experience (e.g., high layers, rare natural catastrophes and fast-changing exposures) and also as a “second opinion” for experience-based rated treaties, it has become normal practice to simulate ground-up losses several thousand times and to calculate the necessary ROL for a given layer by means of so-called probabilistic loss exceedance curves.

The first applications of respective natural catastrophe simulation models date back to the 1980s. Examples of providers of worldwide vendor models include Applied Insurance Research (AIR), Risk Management Solutions (RMS) and EQECAT. The major reinsurers also have their own models for some catastrophe risks. These models consist of three parts: simulations of natural catastrophes, calculation/simulation of damages caused by the respective catastrophes and calculation/simulation of the insured losses following the damages. (Please refer to the Natural Catastrophe Risk Modelling chapter of the Risk Book for greater detail.)

Catastrophe model output is highly dependent on the quality of the input data, which can easily reach the terabyte range for large insurance undertakings. Ensuring the accuracy of the input data is therefore crucial for this kind of exposure pricing.

The advantage of this kind of probabilistic outcome is that it not only shows the expected value of losses (the so-called net risk premium), but also the full probability curve of results. That allows the calculation of various types of risk margins. This starts with “simple” treaty-related charges; e.g., charges expressed as percentages of the standard deviation or – more commonly – converting this into the respective percentages of the net risk premium, the so-called multiplier. For infrequent events – e.g., in the 1% range (1 in 100 years) – the risk charge will often exceed the net risk premium. More advanced techniques compare the capital requirements for a portfolio without a respective treaty with the portfolio including this particular treaty and determine the risk margin by means of the expenses for serving the additional (marginal) capital.

## 6.3. Reinstatements

Especially for natural catastrophe XLs, it is usual to agree upon how many limits are available for a given year and how reinstatement premiums for reinstating limits after loss events are calculated. A limit is the amount of coverage available under the contract and if the limit is exceeded during the coverage period, then the contract normally allows for the limit to be restored subject to payment of a reinstatement premium. When trying to assess the “net” situation after certain events it is therefore

necessary to fully reflect the impact of any reinstatement premiums. Reinstatement premiums are mandatory once an event occurs, assuming that the contract allows for the limit to be restored.

For reinsurers this usually has two opposite effects: reinstatement premiums received from cedants after events will reduce their net position, while any reinstatement premiums they pay for their own protections (retrocessions) will add to the total loss.

## 7 Effects of Non-proportional Reinsurance

This section focuses on non-proportional reinsurance due to the way that non-proportional structures can significantly change the risk profile of a company through the reinsurance of peak risks. Proportional reinsurance structures tend to have a proportional effect on the risk profile of the insurer with a similar effect on the required capital and volatility of emerging profits. Where a proportional structure can have a significant effect on the risk profile is when a major line of business with significant risk relative to other lines of business is reinsured, thereby resulting in a more uniform risk profile. However, while proportional reinsurance can achieve this result it is normally less efficient than using a non-proportional structure.

Proportional structures in L&H reinsurance are often proportional above a specified retention by the cedant for each underlying contract. In this instance the capital benefit can be quite different (higher) than the impact on income.

### 7.1. Volatility Reduction

Depending on the limit and layer structure, a significant volatility reduction (not only for the portfolio in question but for the entire risk profile of the cedant) is possible, as non-proportional reinsurance typically transfers major “tail risks” of loss distributions from cedants to reinsurers (e.g., for natural catastrophes).

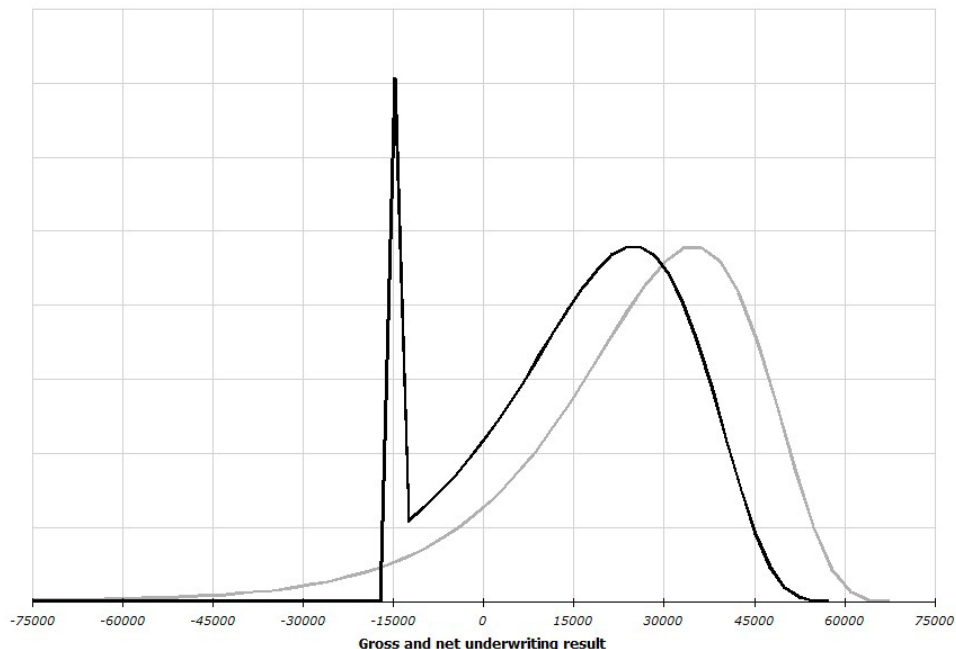


Figure 3: Volatility reduction by non-proportional reinsurance

The smooth curve in the above graph shows the distribution of the expected gross result. The other curve is the distribution of the expected net result after buying reinsurance which protects the portfolio against losses in excess of 15,000.

## 7.2. Diversification Improvement

While only a few insurance undertakings are globally active, it is the core value proposition of reinsurers that they carry out their business worldwide. This allows for the utilization of powerful diversification effects worldwide – e.g., for natural catastrophes: U.S. windstorm events with Japanese earthquakes, Californian earthquakes with European windstorms and floods, Australian brushfires with Canadian blizzards. All perils on all continents are diversifying each other, even if it is sometimes not “perfect” (e.g., if certain global trends like climate change are gradually worsening multiple global meteorological perils).

This can be illustrated in the following example.

Assume two independent catastrophe risks have to withstand the 1-in-200-year situation (i.e., Solvency II standard).

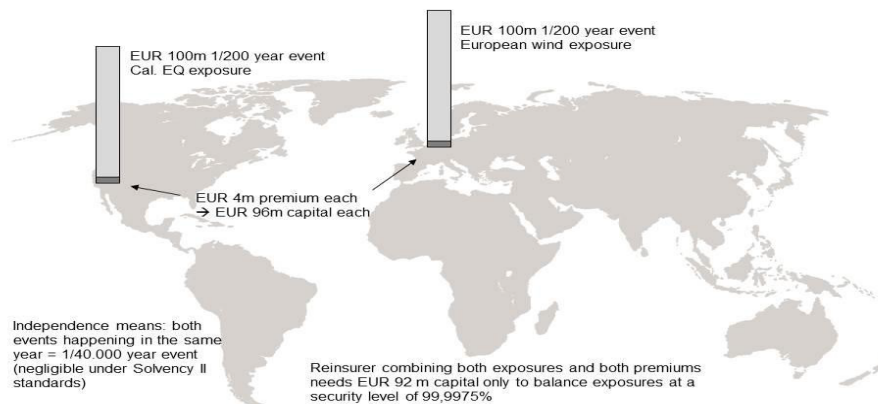


Figure 4: Worldwide diversification

## 7.3. Improvement of Risk/Return Relations

Let us consider again the example in Section 7.1. The gross distribution of underwriting results shows a higher expected result than the net distribution. However, the tail is less severe for the net distribution due to non-proportional reinsurance. Hence, the net distribution has a lower volatility. To compare the two respective risk/return relations, one can look at the so-called return on risk adjusted capital (RORAC), which is significantly higher with the reinsurance cover than without (at the 0.5% value at risk, or VaR, over one year). The following “ideal” example excludes considerations such as the validity of the VaR approach, model risk and market behaviour.

	Gross	Net
Mean Underwriting Result	24,996	16,270
0.5%-Percentile	-50,235	-15,000
RORAC	49.8%	108.5%

In this case the reduction in required capital far outweighs the reduction in expected profit.

#### 7.4. Capacity Increase

Assume a regional primary insurer can write property risks up to a 100-year loss of US\$50 million. When the company reaches this level, it has to stop writing risks although the forgone business might be very profitable. A non-proportional reinsurance cover in excess of US\$50 million would enable the company to write further business without being limited to its 100-year gross loss.

Assume another primary insurer can take single risks up to a total sum insured of US\$1 million. Its limited capacity leads to rejection of risks above that threshold. This circumstance results in a limited ability of the insurer to further diversify its portfolio (e.g., geographically or by line of business) by writing more risks. Non-proportional reinsurance attaching at US\$1 million would allow the insurer to enhance its diversification as it will get access to an increased number of risk types. It is beneficial for the insurer if it can steer its overall risk profile with a maximum degree of flexibility.

Hence, non-proportional reinsurance can serve as a means to increase an insurer's capacity.

## 8 Intra-group Reinsurance Transactions

Intra-group reinsurance transactions (IGRs) are essentially the same as similar reinsurance transactions between two unconnected regulated legal entities, and much of the rationale for entering and executing such transactions is identical. They are an important tool for groups and their subsidiary companies to manage capital efficiency and risk throughout the group structure.

The rationale for IGR transactions is similar to normal reinsurance transactions except that the transacting legal entities of an IGR ultimately have the same parent company and shareholder, which gives rise to the need for special considerations. In addition, the presence of a third party, namely the group, which will exert its own influence, requires that a good process and good governance are in place. Additionally, such transactions often attract increased scrutiny from regulators and other bodies.

IGRs are useful within a group for managing risk and capital across the entire organization. IGRs are often used in a group as an alternative to increasing the capital within a subsidiary company as they can be used to transfer risk to another subsidiary company where there is surplus capital.

As explained earlier, there are various potential drivers for reinsurance. Capital requirements and the diversification of risks are common considerations that motivate reinsurance. In the context of capital, the ceding company may need to consider the advantages and disadvantages of a reinsurance transaction as opposed to some other form of capital support. When the ceding company is a subsidiary

of a group then this decision has also to consider the needs of the overall group, including the willingness to inject capital into the subsidiary or provide other forms of support.

### **8.1. Structuring an IGR**

The IGR structure depends upon the intended outcome. One aiming to reduce the overall capital requirement of a ceding legal entity will be different to that seeking to reduce profit and loss (P&L) volatility.

One form of an IGR arrangement arises when companies within a group participate in a pooling structure. While much of the same considerations apply here as with a standard IGR, there are some differences. Linked to this point, internal reinsurance is also used to allow the transfer of risks from legal entities licensed to sell insurance in certain jurisdictions to the legal entities where groups intend to manage and diversify the said risks. Such pools are common in at least one region (i.e., the U.S. for P&C groups). For solvency regulation purposes, the quota share pool within the group is sometimes viewed as a single entity rather than a collection of entities (e.g., with a single actuarial reserve opinion/report covering the entire pool and its multiple entities).

### **8.2. IGR Governance**

An IGR is between two related subsidiary companies, and this effectively brings in three parties to the transaction. Not only do the needs and benefits of the two potentially transacting companies need to be considered, but also that of the group as a whole. In most circumstances “group” is normally defined as the ultimate shareholders who are represented by corporate-centre-type functions. However, it is also possible for groups to have sub-holding companies or subsidiary entities who are responsible for managing the companies within the subgroup. The group’s corporate centre will normally have its own views on the appropriateness of any IGRs, particularly whether they are in line with group strategy and are beneficial to the group as a whole. IGRs can take place between any two related companies within a group structure; i.e., either horizontally or vertically. It should be noted that a branch office cannot perform an IGR with its parent company as it is part of the same capital base. Nevertheless, a subsidiary company can carry out an IGR with its parent as both companies will have the own individual regulated capital requirements to accommodate.

Although ultimate responsibility rests with the local company management teams and their respective local boards, there are many parties who should be involved in giving their opinion before agreeing to proceed with an IGR. In respect of an IGR between two group companies it is the responsibility of both sets of boards and managements to look at a potential IGR from their own company perspective and decide whether such a transaction is in the interests of their local legal entity. A transaction that is beneficial for the group overall but adverse from a local perspective should normally be rejected.

An IGR process can give rise to conflicts of interest for the people involved. It is important that the participants in the process understand for whom they are advising or for whom they are taking a decision. In particular, if IGRs are between two companies of the same group operating in separate regulatory environments, then anyone giving advice or taking decisions should consider the IGR from the perspective of either the ceding company, the assuming company or the group as a whole, in order not to confuse issues between the different parties. Individuals who have an interest in both the ceding and assuming company need to be alert to potential conflict of interest issues.

To make sure that good governance is applied, it is best practice for the group to have an IGR governance policy, detailing the roles and responsibilities of the various parties and individuals who would be involved in the process. This policy should contain guidance on how individuals should deal with actual or potential conflicts of interest.

### 8.3. Negotiation

Active negotiation may need to be evident for an IGR to be approved. From a transfer pricing perspective, it must be possible to clearly show that the transaction pricing is within the range of what could be observed within the market in which the company operates. If there is no market for similar type transactions, then comparisons against other measures will need to be carried out and documented. In addition, it should be clear that the transaction has been entered into for sound business reasons, otherwise the local tax authorities may disallow any actual or perceived tax treatments.

The actual approach to pricing the transaction will depend on how the group delegates pricing methodology and target returns. If the two companies have full control over pricing, then each will use its own respective methodologies to form a view on what price will meet its respective target return. However, some groups impose consistent pricing methodology and target returns across the company. Some groups will have groupwide in-house models to price business. In this case both group companies will look at the potential deal in a similar way. The latter approach can also mean that many of the underlying assumptions will be viewed identically in both the ceding and assuming companies, with the only differences in respect of expenses, tax and capital assumptions.

Ideally, there should be evidence of active negotiation between the two parties. In most cases, this will end with an agreement to go ahead with the deal. In other instances, the two companies may remain apart and unable to conclude a deal, most possibly because of price return targets. In the latter case, the group needs to get involved to see if the gap in price can be bridged, because a good deal for all parties should not be stopped because of high target returns imposed by the group. An example is if the group has the policy of a return of  $x\%$  on economic capital. In this case the group may need to relax its approach (i.e., reduce the  $x\%$ ) to create the opportunity for the ceding and assuming companies to be able to bridge the gap in price.

Pooling-type arrangements or IGRs carried out within the same regulatory environment may require less negotiation, although this depends also on the actual tax regime in force. For example, depending on the exact structure of a pooling arrangement, there is most likely little negotiation between the differing parties, yet each party's interest will still be adequately represented because they are inter-connected, and the group will play a strong coordination role.

IGRs are basically transactions between two friendly companies. Therefore, it should be possible to structure the transaction in a way that keeps administration at a minimum. An IGR will add to the overall costs, so it is in the interests of all parties to keep the additional costs to a minimum.

Contract wordings need as well to be negotiated and agreed. Again, this should be relatively straightforward due to the relationship between the two parties to the transaction. However, given the potential long-term nature of such business, it is important that both parties have a contract that protects them in the same way as contracts with external parties would do. There is always a possibility

that over time the group structures change as companies are merged or sold, which can change an IGR contract from an internal one into an external one.

Any impact on accounting should have been considered as part of the approval process. Again, the accounting should be efficient and not give rise to any excessive burden for either party. Reserving practices may differ between the ceding company and the assuming company, particularly when the transaction is cross-border. In addition, reserving for insurance business may have different requirements to reserving the same business as reinsurance.

Generally, when an IGR is written cross-border, then it will be more complex. Different regulatory regimes and taxation approaches will need to be considered. Depending on the structure of the IGR, currency risk could become relevant, although this can normally be reduced with appropriate asset and liability management.

One of the issues that may concern regulators is that an IGR, or an increased use of IGRs, could give increased exposure to group risk. Reinsuring across the group means that the ceding company's ongoing solvency can become more and more dependent on the ongoing solvency of the wider group. The ceding company has basically a concentration risk to another group company or the group in total. There are mechanisms, such as deposit of reserves, collateral triggers, etc., to mitigate or partially mitigate this impact, but the ceding company needs to consider what happens if the wider group gets into trouble. Even on an ongoing basis, additional capital may be required to cover the risk of group failure, and this should be considered as part of the overall IGR process.

Finally, both the ceding and assuming companies need to be able to carry out the ongoing management and monitoring of any IGR and assess whether it performs in the way expected. This analysis needs to be reported to local management, local boards of directors and the group regularly.

#### **8.4. Use of Special Purpose Vehicles**

Another form of IGR includes the ceding of risks into a special purpose vehicle (SPV). Usually, SPVs are funded by capital raised from investors outside of the group, but they can be used to bring capital from one group member to meet risk in another. In this intra-group context, the considerations are closely aligned to those for an IGR. The presence of the SPV creates an additional legal entity that needs to meet the local legal, tax and regulatory requirements.

#### **8.5. Systemic Risk Considerations**

The use of IGRs increases the interconnectedness between companies within the same group; hence, a problem in one company within the group could also appear in one or more other group companies and thereby increase systemic risk. The counter point is that the spreading of risk is the primary function of insurance, which has the effect of lowering the overall level of risk.

IGRs themselves do not increase systemic risk provided that each company has good risk management practices and understands the different risks on its balance sheet. This includes the exposures they have to other company failures, either to other group companies through IGRs or to external reinsurers. The group itself has the responsibility to look at crisis scenarios and consider how risks flow throughout the group during the failure of a group company.

## 9 Capital Effects of Reinsurance

It is normal in any regulatory risk-based capital requirement for reinsurance to be taken into account, thereby lowering the solvency requirement of the ceding insurer. In the paragraphs below the references to Solvency II should be understood more as an illustration rather than as referring to the only existing regulatory framework.

### 9.1. Substantial Decrease of Insurance Risk Capital

Under Solvency II, reinsurance is taken into account when calculating the Solvency Capital Requirement (SCR) “provided that credit risk and other risks arising from the use of such techniques are properly reflected in the Solvency Capital Requirement” (Directive 2009/138/EC Article 101 (5)). In this section we will consider the impact of reinsurance on the SCR, and in the following section will further describe the corresponding credit risk.

In general, the SCR calculation is divided into modules as shown in Figure 5:

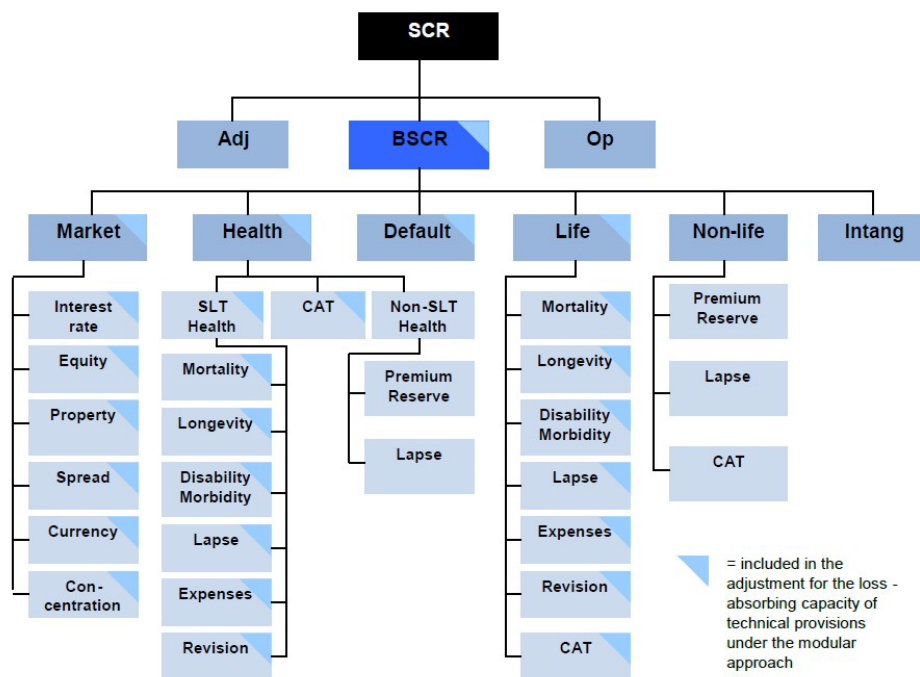


Figure 5: SCR composition according to Solvency II specifications

The capital requirements on lower levels are aggregated using correlation assumptions. Reinsurance can significantly reduce the SCR for many of the risks listed. For example, a significant impact is often felt through reinsuring catastrophe risk on a non-proportional basis. The premium risk SCR can also be decreased by non-proportional reinsurance for life-related risks (especially catastrophe risks) if appropriate covers exist.

Theoretically the following holds: the higher the volume of reinsurance in terms of risks ceded and the higher the weight of the covered risk module, the higher the effect of reinsurance on the total SCR.

## 9.2. Potential Increase of Insurance Risk Capital

As explained above, Solvency II allows an insurer to take reinsurance into account as well as charging for the credit risk of the reinsurance at the same time. However, the risk mitigating effect of reinsurance is generally much greater than the increase of risk capital by credit risk, although the actual effect depends on the credit quality of the reinsurer. Other capital models have similar features, including the National Association of Insurance Commissioners' (NAIC) risk-based capital (RBC) formula for P&C companies, as well as International Capital Standards.

The credit risk mainly depends on the rating (or other credit metrics if a rating is not available) of the counterparty with which reinsurance is placed. Under Solvency II, the rating impact on capital is much greater than the capital effect of diversification of counterparties (i.e., placing reinsurance with several reinsurers). It should also be noted that the risk charge for a reinsurer defaulting on its obligations with its cedants is lower than the implied risk of default based on the credit rating of any debt issued by the reinsurer. (This is particularly so when the debt is issued by the holding company of the reinsurer and the reinsurer itself is an insurance regulated entity.)

Many capital models also allow for collateralization where it exists. In theory the credit risk can be reduced to zero if all reinsurance contracts are fully collateralized. However, the overall effect may be limited as credit risk for reinsurance is generally small.

## 9.3. Solvency Ratio Improvement

Modern solvency regimes around the world allow for the impact of reinsurance. Solvency II allows for reinsurance subject to the credit risk connected to the reinsurance arrangement being allowed for appropriately. The Solvency II framework considers the benefit of reinsurance not only from the perspective of exposure management, but also in view of a company's overall capital and risk management. The risk mitigation effect of reinsurance is also reflected in an increase of own funds due to a lower so-called risk margin being part of the market value of liabilities (see Figure 6).

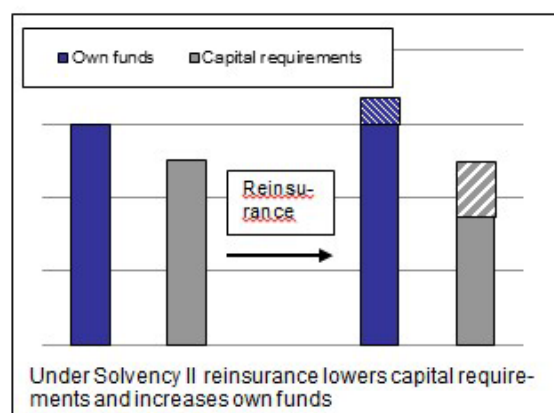


Figure 6: Effects of reinsurance under Solvency II

Another example is in the U.S., where in the U.S. NAIC P&C RBC formula, introduced in 1994, reinsurance is reflected by applying risk factors based on and applied to data by line of insurance net of reinsurance, along with a charge for credit risk based on stressed reinsurance balances by credit rating.

With regard to catastrophe risk, the NAIC's formula for P&C companies is based on utilizing each insurer's catastrophe model results for the earthquake and tropical cyclone risks net of reinsurance (with a small reduction for the related credit risk). This approach allows for full recognition of an insurer's reinsurance program for these perils.

#### **9.4. Rating Impact**

Reinsurance also has a positive impact in the capital models of most rating agencies (e.g., Standard & Poor's, A.M. Best). For non-life, this is especially true for non-proportional catastrophe reinsurance. In general, the non-life capital models distinguish between "premium risk" for attritional losses and "catastrophe risk" for large property losses. Premium risk is determined by reference to net premium volumes; i.e., the reduction in required capital through non-proportional reinsurance is only proportional to the amount of ceded premium.

The respective base risk factors are determined by using industry data net of reinsurance, thereby reflecting the industrywide impact from all types of reinsurance. For individual companies, however, the premium risk models treat proportional and non-proportional reinsurance in the same way. At least some of the rating agencies also allow for judgmental adjustments in these models, which could include reflecting the characteristics of an individual company's reinsurance program.

The rating agencies' catastrophe models look at certain scenarios (e.g., 1/100yr European Wind) and their net impact on the P&L (i.e., net after reinsurance and inward and outward reinstatement premiums) or at a "convoluted" net 250yr-VaR of the property portfolio ("S&P net gap"). In both cases, the actual reinsurance structure can be applied, which in essence means the full limit of any non-proportional reinsurance is used if applicable – and not only the ceded premium. All in all, non-proportional reinsurance can be tailored to get the most efficient relief also in the context of capital models of rating agencies.

## **10 Reinsurance and Regulation**

### **10.1. Business-to-Business Character of Transactions**

The supervisory protection needed for direct insurance clients in principle does not necessarily apply for reinsurance relations as both business partners are "knowledgeable parties". For this reason, reinsurance in many countries (especially in Europe) was only supervised to a limited extent until the end of the last century. When applying general supervision principles to reinsurers it still should be recognized that both partners are informed business professionals with knowledge about risks. This holds even more for large international undertakings.

### **10.2. Powerful Risk Management Tool**

Reinsurance structures are an effective risk mitigation tool as they can be structured to achieve a targeted risk position. This starts with "micro solutions" on a facultative basis, special protections for certain pieces of business (like lines of business), protection for entire portfolios and even protection of the entire operation of an insurer.

### 10.3. Importance of Full Recognition

Because of the risk effectiveness of reinsurance, it should be recognized in supervisory considerations, especially in respect of capital requirements, if the desire is to accurately reflect the risk transfer. This holds for both parties – reinsurers and cedants: any significant change in the overall risk situation incurred by reinsurance arrangements should be reflected in the respective capital requirements.

### 10.4. Cash Losses and Collateralization

For short-tail business (like fire) it is common to have a provision in the contract that in case of a major loss a certain part of the loss estimate (e.g., 50%) can be called upfront by the cedant as “cash loss” payable in advance by the reinsurer. For the remaining part of the loss a loss reserve is established by the reinsurer.

For long-tail business it is unusual to agree upon cash loss provisions as the loss usually requires some time to become settled. Here it is important for the reinsurer to establish a reserve as close to the final settlement as possible.

A possible solution to eliminate the credit risk on outstanding reserves for the cedant is to require “collateral”; i.e., a payment guarantee or dedicated assets such as in the form of a trust fund or a deposit of reserves. These mechanisms provide protection in the case of problems in receiving payments from the reinsurer. One such very common instrument is a “letter of credit” (LoC) provided by a bank in favour of the cedant. The expenses of LoCs usually have to be borne by reinsurers and can reach substantial amounts, running into many millions over time. LoC costs increased substantially after the financial crisis and are now considerably more expensive than trust funds.

Reinsurers try to avoid these expenses by claiming that their credit risk is remote and that the usual contractual provisions are sufficient to secure claim payments. In certain jurisdictions it is required that collaterals are in place for the cedant to get the respective balance sheet relief. All forms of collateral have associated costs and these form part of the reinsurance price. In certain jurisdictions the rules for collateral vary between reinsurance placed with domestic reinsurers and reinsurance placed with reinsurers based outside of the country, which may lead to political discussions.

### 10.5. Systemic Risk Mitigation

In contrast to widespread views about systemic risk contribution of traditional reinsurance, it must be emphasized that the opposite is normally true: reinsurers’ capital typically acts to a moderate degree as a mitigating instrument for balancing capital market distortions, particularly in the case of major (natural) catastrophes.

## 11 Complementary Risk Mitigation Instruments

### 11.1. Industry Loss Warranties

Industry loss warranties (ILWs) are binary covers that depend on the overall market loss. A certain limit is paid to the insured when the total market loss reaches a predefined threshold (e.g., a limit of US\$50 million is paid when the market loss of a Californian earthquake exceeds US\$80 billion). Hence, ILWs are

quite simple from a structural point of view. However, they may bear a significant basis risk for the insured compared to a traditional non-proportional cover if the covered portfolio does not behave like the market (i.e., there might be a huge loss to the insured, but the market loss has not reached the required threshold). The index may also be subject to modification or imprecise measurement and develop over time. It is up to the insured company whether it wants to bear the basis risk in exchange for potentially cheaper cover.

## 11.2. Catastrophe Bonds

The reinsured exposure under “traditional” non-proportional reinsurance – usually a multiple of the premium volume – still bears a level of residual risk: the “credit risk” of the reinsurer, especially in case of major catastrophes. This could especially be a material consideration for reinsurers, buying “retrocessional” protection from fellow reinsurers to protect “peak” exposures in cases of very large catastrophes with “high” return periods (e.g., 100 years).

It was therefore no surprise that a reinsurer in 1994 “invented” so-called “securitizations”, where the entire amount of protected exposure is capitalized in advance, preferably as an investment from capital market participants with limited correlation to natural catastrophes. The “premium” is regarded as a “return on investment” in a case of no losses, whereas the invested “principal” amount will be lost in a case of the respective major loss occurrence.

To facilitate such a construction, it is usual to establish an SPV, domiciled in a suitable environment. A reinsurance treaty will transfer the exposures and the respective premium into a protected account of the SPV, and in turn investors will invest in bonds or notes issued by the SPV. To justify the still significant expenses, these types of investments have historically exceeded US\$100 million and are done for more than one year (usually three to five years). The settlement period can be extended even further in the event of a catastrophe to allow for the time it takes until losses are fully known and paid.

The performance of those bonds or notes is linked to the loss experience of the respective exposures, which are clearly described and modelled in the offering memorandum. It is common practice to use a third party (e.g., a catastrophe model vendor) to model the probabilistic curve describing the potential losses and to express the return (“spread”) in excess of the risk-free rate (usually LIBOR historically) as a multiple of the expected losses. The bonds are usually rated for risk by one or more of the rating agencies in a similar way to corporate bonds or similar instruments.

The key for marketability of these products is clear, reliable and foreseeable modelling. It is no surprise that this holds for familiar natural catastrophe exposures in prominent locations like the U.S., Europe and Japan. Other short-tail business (aviation, marine) is sometimes securitized. It is still rare to convince investors to invest in long-tail exposures (e.g., general liability) where loss reserve deviations form part of the risk. Experience shows that investors want resolution of the uncertainty in a finite, relatively short period (say three to five years).

## 11.3. Catastrophe Swaps

Instead of transforming a catastrophe exposure into a fixed premium, it is possible to exchange different exposures directly between two parties. This requires a modelled “exchange rate” which is acceptable to both parties. If this can be achieved – usually through the application of accepted natural

catastrophe models – two undertakings with “peak” exposures in different parts of the world can swap; e.g.,  $x$  units of European windstorm exposure being swapped with  $y$  units of Japanese earthquake exposure within a given period.

#### **11.4. Parametric Covers**

Developing from the structures illustrated above is the growing use of parametric covers where losses are determined based on a parametric trigger rather than actual losses. These covers take many forms, but examples are payouts determined by reference to actual windspeeds, the number of days without rain, average temperatures over a defined period, the number of deaths in a population, etc. The primary driver of this type of trigger is that the definition of claim is clear and the actual amount payable cannot be disputed. Covers involving these types of triggers are also much easier to package for the capital markets. In these structures the insurer runs the underlying basis risk, in that the actual recoveries may be somewhat different from the incurred losses.



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