

# IAA Risk Book

## Chapter 6 – Non-proportional Reinsurance

Michael Eves

Alexander Fritsch

Eberhard Müller

### 1. Executive Summary

Reinsurance is a powerful risk mitigating tool for insurance undertakings, particularly nonproportional reinsurance, which allows insurance companies to transfer significant parts of tail risks—be it for single losses or for entire portfolios—to reinsurers at a given price. Reinsurers typically have the ability to diversify risks worldwide (e.g., for natural catastrophes) and between different lines of business (e.g., property and casualty (P&C)). This allows a very efficient use of capital, which forms the basis for creating significant capital relief for reinsurance buyers. In turn the credit risk and liquidity risk associated with the outstanding reinsurance have to be considered.

The key messages include:

1. Nonproportional reinsurance is a very powerful tool in spreading risk and diversifying risk.
2. Nonproportional reinsurance is used extensively in P&C reinsurance but is less common for life and health insurance where proportional reinsurance continues to dominate.
3. In addition to risk and capital considerations, nonproportional reinsurance is used extensively to reduce the potential volatility of a company's quarterly or yearly earnings.
4. The risk assessment and the pricing of nonproportional reinsurance products are reliant upon having good meaningful data. This contributes to the overall improvement of data quality, especially for smaller insurers.
5. As regulatory capital regimes become more risk based it is likely that nonproportional reinsurance solutions will become more common across all lines of business.
6. Nonproportional reinsurance structures, and reinsurance in general, carry a risk in respect of a failure of the reinsurer. This risk needs to be carried in the capital requirements.

### 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 nonproportional reinsurance, as it allows the cedant to substitute substantial (expensive) amounts of its capital with lower (cheaper) capital of reinsurers as they are able to turn worldwide diversification effects into capital credit. In this sense reinsurers do nothing other than apply the “principle of insurance” for insurance undertakings in the same way as insurance undertakings provide the “principle of insurance” for their clients.

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It needs to be noted that by transferring risk to a reinsurer the cedant takes on counterparty credit risk and additional liquidity risk in the event of the failure of the reinsurer. In general this is a much lower risk than the 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.

### **3. Which Kinds of Reinsurance Are Normally Considered?**

#### **I. Facultative vs. Treaty.**

Facultative reinsurance typically is 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. “Treaty reinsurance” is normally organized by geographical regions and/or lines of business.

#### **II. Proportional vs. Nonproportional.**

Proportional reinsurance typically shares the fortunes between cedants and reinsurers in a proportional manner—be it on given single exposures by “slices” (surplus treaties) or for entire portfolios (quota share treaties). Premiums and losses are shared by the agreed ratio, adjusted by a compensation for cedants for their business generation and administration expenses (reinsurance commission).

Nonproportional 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 nonproportional reinsurance are agreed upon between cedants and reinsurers. This can be done through direct negotiations or through (reinsurance) brokers. It is usual that comprehensive 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.

#### **III. Short-Tail vs. Long-Tail.**

Depending on the run-off behaviour of losses 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 nonproportional 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). 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 run-off 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

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“claims made” means that only claims notified in a given period are covered while “loss occurrence” policies cover losses when they occur—even 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 knife 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 after further 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.

#### **IV. Direct vs. Brokered.**

Sometimes reinsurance is differentiated between direct business (business relation between cedant and reinsurer without an intermediary) and brokered business. 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 solve disputes.

The charge for these services 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 about 1–1.5 percent, it can be quite significant for nonproportional treaties reaching 10–15 percent. This charge therefore constitutes a material part of the pricing considerations.

### **4. Types of Nonproportional Reinsurance**

#### **I. Why Nonproportional Reinsurance.**

Proportional reinsurance has only two major adjustment factors: the sharing ratio and the commission. In all other aspects the reinsurer usually “follows the fortune” of the cedant. In contrast, nonproportional 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) but also to the set of conditions surrounding the treaty, including event definitions (e.g., hourly clauses for storm events), inclusions/exclusions, and cash loss provisions.

#### **II. Excess of Loss Reinsurance.**

Excess of loss (XL) reinsurance transfers losses beyond a certain threshold (retention) from cedants to reinsurers. This can be done for single losses, events, or a combination thereof. Typically 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 but uncommon.

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A. Per Risk XL

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

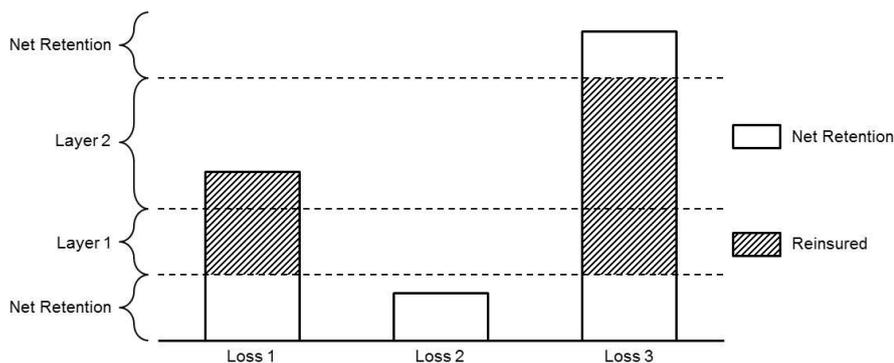


Figure 1: Example Per Risk XL

B. Catastrophe XL

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

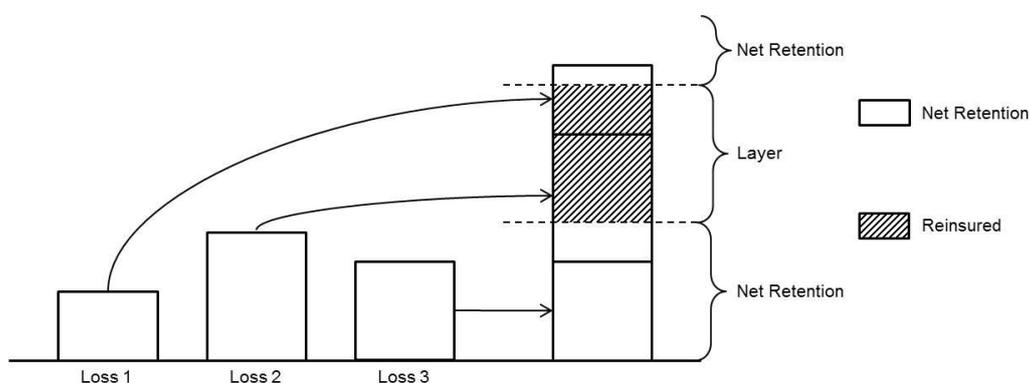


Figure 2: Example Catastrophe XL

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 percent excess of 110 percent loss ratio).

D. Life vs. Nonlife

While in principle the same kinds of nonproportional reinsurance are available for life and health reinsurance, it is currently far more important for nonlife 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 nonproportional reinsurance as defined for P&C business, has also been used.

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Nonproportional life reinsurance is typically placed on a per life basis over a fixed sum assured, e.g., all risks are reinsured over 50,000 sum assured for each individual life. Nonproportional 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 period—for example, 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 nonproportional reinsurance structures will grow in this area. Now the capital markets are developing nonproportional types of covers aimed at protecting certain levels of excess mortality. Mass lapse risk is also another area where nonproportional-type reinsurance structures are developing.

## 5. Pricing of Nonproportional Reinsurance

### I. 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, and in some cases this could result in decreasing historic losses due, for example, to tort reform for liability claims or effective loss prevention measures like sprinkler devices. On balance trends are generally increasing 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 are increasing. The consequence is that for very infrequent events—e.g., return periods of 100 years (1 percent “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) shown in the table below, a nonproportional reinsurance layer 1000xs1000 (free reinstatements—see paragraph c below for further discussion of reinstatements) and the corresponding losses to that layer.

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Year	Incurred Loss (fgu)	Loss to Layer (1000xs1000)
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 premium is divided by the total losses 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
Net Rate	6.22%	

Eventually, a net rate is derived for the reinsurance premium of 6.22 percent. 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 treated above.

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Through various types of profit commission arrangements, i.e., the 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.

## **II. Exposure-Based Methods.**

For treaties with insufficient loss experience (e.g., high layers, rare natural catastrophes, and fast-changing exposures) and also as “second opinions” for experience-based rated treaties, it has become common 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 late eighties. Currently there are three major providers of worldwide vendor models—Applied Insurance Research (AIR), Risk Management Solutions (RMS), and EQECAT. The major reinsurers also have their own models for some catastrophe risks. All of 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.

Catastrophe model output is quite 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., 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 percent range (1 in 100 years), this can easily reach multipliers of four, i.e., the risk charge is three times 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. For practical purposes it is common to combine both techniques.

## **III. Reinstatements.**

Especially for natural catastrophe XLs, it is usual to agree upon how many limits are available in a given year and how reimbursements (reinstatement premiums) for reinstating limits after loss events are calculated (pro rata capita, pro rata temporis, or a combination thereof). Of course these reinstatement premiums are due immediately after “triggering” events occur and usually will be offset against the loss payments.

When trying to assess the “net” situation after certain events it is therefore necessary to fully reflect the impact of reinstatement premiums.

For reinsurers this usually has two opposite effects: Reinstatement premiums received from cedants after events will mitigate their net position while reinstatement premiums they have to pay for their own protections (retrocessions) will add to the losses.

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## 6. Effects of Nonproportional Reinsurance

### I. Volatility Reduction.

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

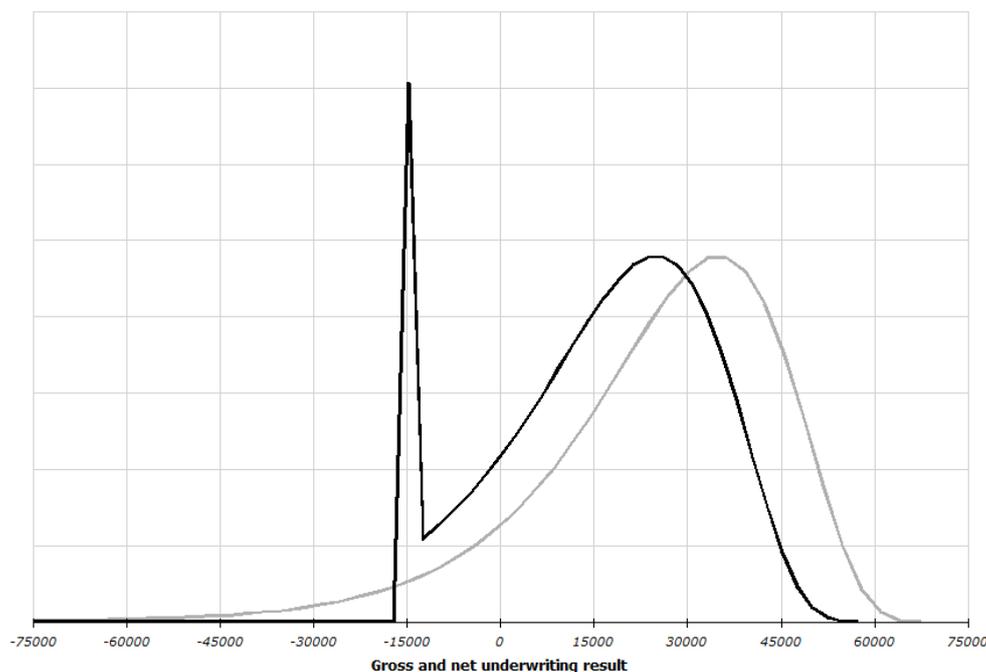


Figure 3: Volatility reduction by nonproportional reinsurance

### II. Diversification Improvement.

While only a few insurance undertakings are really globally active it is the core value proposition of reinsurers that they carry out their business worldwide. This allows the utilisation of powerful diversification effects worldwide—e.g., for natural catastrophes: US windstorm events with Japanese earthquakes, Californian earthquakes with European windstorms and floods, Australian brushfire 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 global warming are gradually affecting all global meteorological perils the same way).

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).

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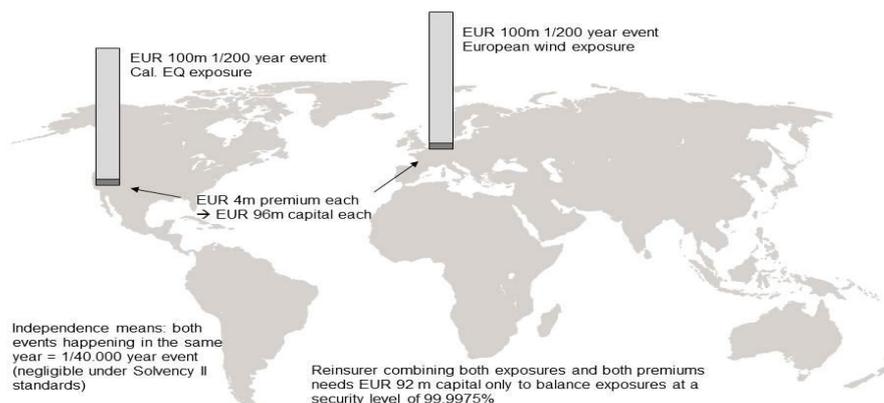


Figure 4: Worldwide diversification

### III. Improvement of Risk/Return Relations.

Let us consider again the example in section A. The gross distribution shows a higher expected underwriting result than the net distribution. However, the tail is less severe for the net distribution due to nonproportional 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 percent value at risk (VaR)). The following “ideal” example is of course abstracting from further considerations like 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.

### IV. 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 nonproportional reinsurance cover in excess of US\$50 million would enable the company to write further business without being limited to its 100-year net retention.

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. Nonproportional reinsurance attaching at US\$1 million would allow the insurer to enhance its diversification as the company gets access to more risks. It is beneficial for the insurer if it can steer its overall risk profile with a maximum degree of flexibility.

Hence, nonproportional reinsurance can serve as a means to increase an insurer’s capacity.

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## V. Qualitative Effects.

Data requirements for risk assessment (for complex natural catastrophe treaties in the terabyte range) foster the establishment of information technology (IT) systems and processes and their continuous improvement to avoid unnecessary charges for insufficient data (especially for smaller insurers).

## 7. Capital Effects of Nonproportional Reinsurance

### I. Substantial Decrease of Insurance Risk Capital.

Under Solvency II, reinsurance can be 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 nonproportional reinsurance on the SCR and will further describe the corresponding credit risk in the following section.

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

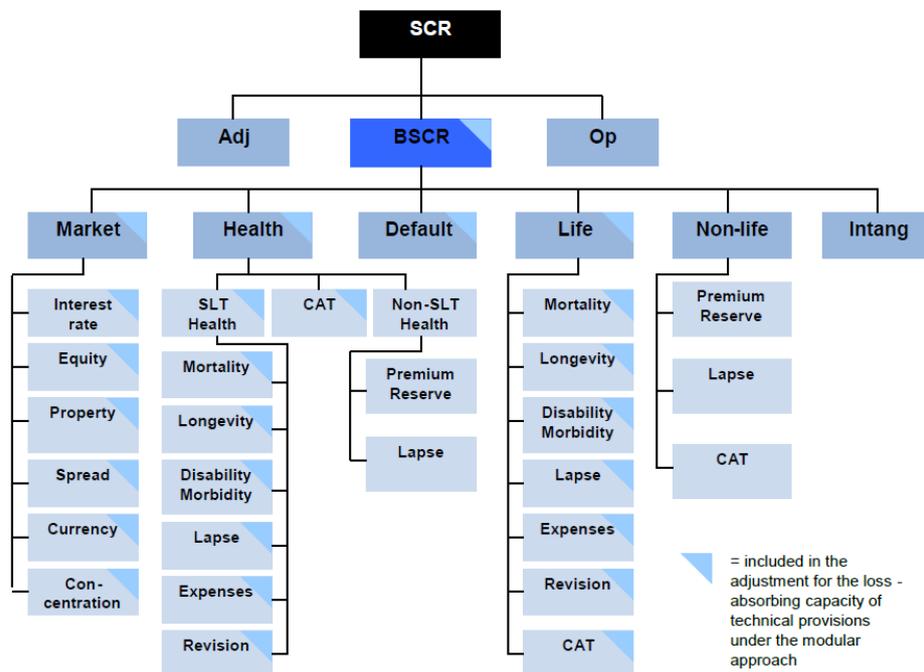


Figure 5: SCR composition according to Solvency II specifications

The capital requirements on lower levels are aggregated on the basis of correlation assumptions.

Nonproportional reinsurance can significantly reduce the SCR for nonlife catastrophe risk. The premium risk SCR can also be decreased by nonproportional reinsurance for life-related risks (especially catastrophe risks) if appropriate covers exist. Theoretically the following holds: the higher the volume of reinsurance and the higher the weight of the covered risk module, the higher the effect of reinsurance on the total SCR. On the other hand it should be

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noted that overreliance on reinsurance also can lead to an increased insolvency risk as recent studies show.

## **II. 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.

The credit risk mainly depends on the rating (or other credit metrics if 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 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 collateralisation but usually reinsurers try to avoid this as it usually brings restrictions they would prefer to avoid. There will also be a cost to the cedant as reinsurers need to charge for any loss of potential income. 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.

## **III. Solvency Ratio Improvement.**

Modern solvency regimes around the world allow for the impact of reinsurance. The solvency regime until 2015 in Europe—Solvency I—takes nonproportional reinsurance into account very simplistically and treats proportional and nonproportional reinsurance in the same way. Reinsurance is only considered to the extent of the respective recoveries in the prior three years. The maximum relief was capped at 50 percent. Therefore, the effect of reinsurance is only oriented toward the past and does not depend on its current exposure at all.

The succeeding regime—Solvency II—allows for nonproportional reinsurance much more explicitly as long as credit risk connected to the reinsurance arrangement is taken into account appropriately (see section A). 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).

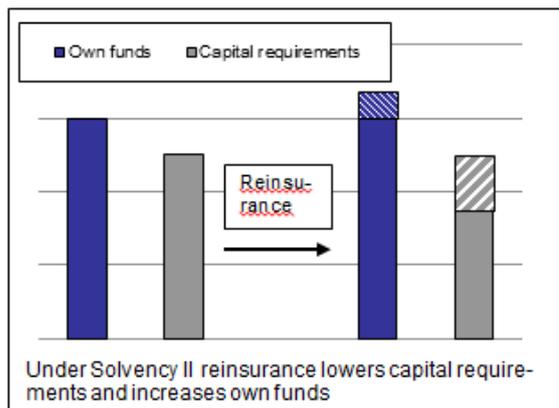


Figure 6: Effects of reinsurance under Solvency II

In the US National Association of Insurance Commissioners (NAIC) P&C risk-based capital (RBC) formula, introduced in 1994, nonproportional reinsurance is reflected only through the use of risk factors based on and applied to data by line of insurance net of reinsurance. Any loss borne by a reinsurer therefore reduces the capital requirement in the first step according to the applicable factor. A side effect can be achieved by improving diversification between lines of business: the lower the contribution of the “peak” line the higher the credit (up to 30 percent if 15 lines have equal size). If peak premiums are reduced by nonproportional reinsurance this will positively influence the credit for “diversification”.

At the time this chapter was written, the NAIC was testing a new catastrophe risk charge for RBC. (The original formula was developed when catastrophe models were still in their infancy; hence it did not include a separate catastrophe risk charge.) Once this is implemented, it will directly reflect the risk reduction features in a particular insurer’s catastrophe reinsurance program by utilizing each insurer’s catastrophe model results net of reinsurance (with a small reduction for the related credit risk).

#### IV. Rating Impact.

Nonproportional reinsurance also has a positive impact in capital models of most rating agencies (e.g., Standard & Poor’s, A.M. Best). This is especially true for nonproportional catastrophe reinsurance. In general, the capital models distinguish between “premium risk” for attritional losses and “catastrophe risk” for large property losses. Premium risk is determined by net premium volumes, i.e., the reduction in required capital by nonproportional reinsurance is only proportional to the amount of ceded premium.

The respective risk factors are determined by using industry data net of reinsurance, therefore reflecting the industrywide impact also of nonproportional reinsurance. For individual companies, however, the premium risk models treat proportional and nonproportional reinsurance in the same way.

The rating agencies’ catastrophe models look at certain scenarios (e.g., 1/100yr European Wind) and their net impact on the profit and loss (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 nonproportional reinsurance is taken into account if

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applicable—and not only the ceded premium. All in all, nonproportional reinsurance can be tailored to get the most efficient relief also in the context of capital models of rating agencies.

## **8. Nonproportional Reinsurance and Regulation**

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

The supervisory protection needed for direct insurance clients in principle does not 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.

### **II. Powerful Risk Management Tool.**

No other instrument allows for the same kind of tailor-made design of a targeted risk position like nonproportional reinsurance. 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.

### **III. Importance of Full Recognition.**

Because of the risk effectiveness of nonproportional reinsurance it should be fully recognized in supervisory considerations, especially on capital requirements, if the desire is to most accurately reflect risk. 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.

### **IV. 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 percent) 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. From average annual expenses between 25bps to 40bps LoC expenses have increased to 75bps to 100bps after the financial crisis, making them nearly 10 times more expensive than trust funds. Typically 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

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reinsurance placed with domestic reinsurers and reinsurance placed with reinsurers based outside of the country, which may lead to political discussions.

## **V. Systemic Risk Mitigation.**

In contrast to widespread views about systemic risk contribution of traditional (nonproportional) reinsurance, it must be emphasized that the opposite is normally true: Reinsurers' capital typically acts, admittedly to a moderate degree, as a mitigating instrument for balancing capital market distortions, particularly in the case of major (natural) catastrophes. This is underlined in research by the Geneva Association.

## **9. Complementary Risk Mitigation Instruments**

### **I. 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 nonproportional 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.

### **II. Catastrophe Bonds.**

The reinsured exposure under "traditional" nonproportional reinsurance—usually a multiple of the premium volume—still bears some sort of residual risk: the "credit risk" of the reinsurer, especially in case of major catastrophes. This is especially true for reinsurers, buying "retrocessional" protection from fellow reinsurers to protect "peak" exposures in case of very large catastrophes with "high" return periods (e.g., 100 years).

It is therefore no surprise that a reinsurer in 1994 "invented" so-called "securitizations", where the entire amount of protected exposure has to be 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 case of no losses, whereas the invested "principal" amount will be lost in case of the respective major loss occurrence.

To facilitate such a construction it is usual to establish a special purpose vehicle (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, 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

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rate (usually LIBOR) as 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.

In the beginning of this type of business it was possible for investors to achieve four times the expected losses as "excess return" (e.g., for the 100-year Californian earthquake or Caribbean hurricane). However, prices meanwhile have come down.

The key for marketability of these products is clear, reliable, and foreseeable modelling. It is no surprise that this holds for plain vanilla natural catastrophe exposures in prominent locations like the United States, Europe, and Japan. Meanwhile other short-tail business (aviation, marine) is sometimes securitized while it is still rare to convince investors to invest in long-tail exposures (e.g., general liability) where also 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).

### **III. 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 with y units of Japanese earthquake exposure within a given period.

### **IV. Other Forms of Securitization.**

In addition reinsurers have started to meet several clients' requests by offering "collateralized" protections, where the covered exposure is collateralized by letters of credit or trust funds, therefore reducing the credit risk for the cedant significantly. As this limits/eliminates the leverage of the respective capital by the reinsurer, it comes with correspondingly higher prices compared to traditional reinsurance.

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Michael Eves, UK qualified actuary, member of SAV, is the group chief actuary of Swiss Re. He is chairman of the Reinsurance Subcommittee of the International Actuarial Association (IAA). Eves can be reached at [michael\\_eves@swissre.com](mailto:michael_eves@swissre.com).

Alexander Fritsch, Dipl.-Math. oec., MSc, Aktuar DAV, CERA, is senior actuary in Hannover Re's dynamic financial analysis department and can be reached at [alexander.fritsch@hannover-re.com](mailto:alexander.fritsch@hannover-re.com).

Eberhard Müller, Dipl. Math., Aktuar DAV, CERA, is chief risk officer and chief actuary of Hannover Re Group. He is a member of the Reinsurance Subcommittee of the IAA. Müller can be reached at [eberhard.mueller@hannover-re.com](mailto:eberhard.mueller@hannover-re.com).

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