In-depth

How Much Reinsurance Do You Really Need? A Case Study.

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Foreword

Reinsurance is a business in constant transformation. Gone are the days when the toolbox of reinsurers was limited to what today is referred to as "traditional" reinsurance. Alternative risk transfer, structured or finite are not buzzwords any longer, they have become common language among reinsurers and their clients. This development has been greatly facilitated by the ability to use more powerful technology and tools to model and simulate simple as well as complex reinsurance structures. Also, we are now able to comfortably go beyond analyzing the range of financial outcomes of reinsurance by including assets allowing for underwriting cycles in the analysis. We are able to expand our spectrum to the performance of the entire enterprise, and when doing so, we use new buzzwords such as Asset Liability Management (ALM) or Dynamic Financial Analysis. One important aspect of ALM is optimizing the reinsurance structure to maximize return, or minimize the volatility of results.

We at Converium have over several years increased our analytical expertise by expanding our global actuarial team adding significant capabilities in financial modelling and the assessment of natural and man-made catastrophes. This team works closely with our clients and underwriters to come up with risk transfer solutions which serve our clients best. This brochure is a study in case showing how we bring together two areas often wide apart in the past: analytical and statistical modelling and underwriting, market and client know-how. It demonstrates how analytical models can, and must, be translated into meaningful insights and practical recommendations for our clients. It is advice that adds value and helps them to run their business in a more effective way.

With the launch of Converium, we present you with our first In-depth study. Further editions of In-depth will be published and focus on aspects of analytical nature – be it statistics, actuarial, modelling of catastrophes or financial markets – and how the results of those analyses can successfully be used to the benefit of our clients.

Hans Peter Boller

Chief Actuarial Officer

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Introduction

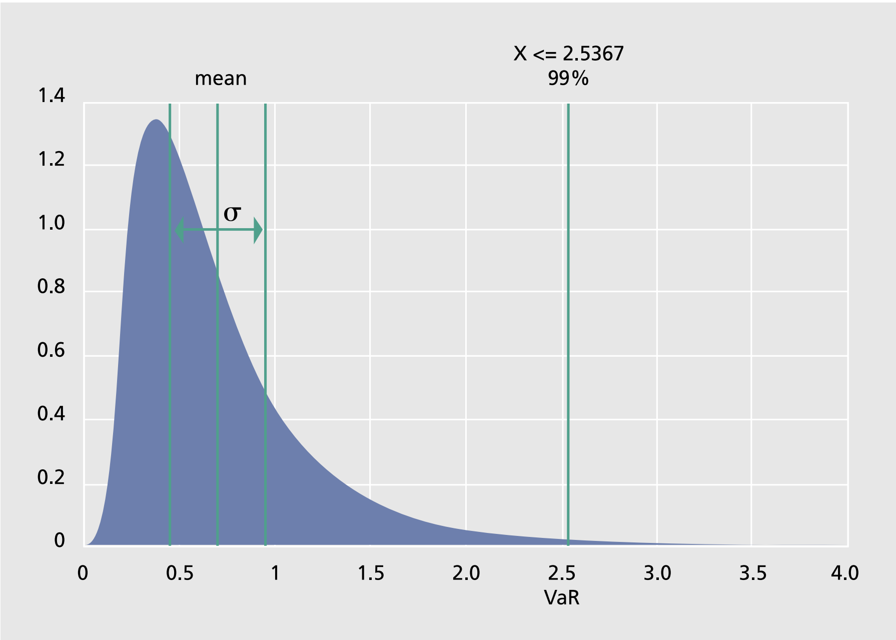
Today's reinsurance manager has to balance many diverging interests. Most prominent among these are the risk-return objectives of the company owners and the security requirements of the policyholders. Performance measurement issues and the sheer number of available reinsurance and capital market solutions further complicate the decision-making process. Given the complexity of the problem, it has been our experience that a quantitative approach can help in understanding the risks and the cost of financing them. This leads to more informed decisions. In this article, we guide the reader through the steps of restructuring an existing traditional reinsurance program using quantitative models of the risks. This is done by means of a case study in which concrete insurance lines are analyzed in a sample portfolio.

Measuring the Risk

What is risk? Risk describes the uncertainty of the future outcome of a current decision or situation. Different outcomes materialize with different probabilities, and the spectrum of all possible outcomes and their probability of happening is typically described by a probability distribution. The world has learned to cope with this uncertainty through different means. One way to manage risk is through taking out (primary) insurance in return for a fee – the premium, which reflects the risk assumed.

Reinsurance is about transferring risk from a primary insurer to a reinsurer. But what is risk in this context? Let us look at the underwriting result of an insurance company. At the beginning of a year there is an expectation about this result, but the actual outcome is uncertain and is driven by the actual outcome of events, such as losses, economic changes and the like. Given an appropriate model, the possible outcomes can be adequately described by a probability distribution. This is an area where actuaries and other professionals traditionally have provided models.

Probability distributions for losses usually appear as follows:



In order to describe the shape and properties of the distribution, various statistical measures have been developed. Most commonly known among these are the mean, the median, and the standard deviation, which is typically used to assess the dispersion of outcomes around the mean. In insurance, and reinsurance in particular, we are mainly dealing with the most adverse outcomes. Those are described by the tail of the distribution. In this context, one often speaks about ruin probability, which reflects the risk appetite of a company, i.e. the degree to which the company is prepared to become insolvent as a result of this probability. Typically, the levels analyzed are 1% or 0.4%, which are often referred to as the 100 or 250 years event, or the 99^{th} or 99.6^{th} percentile, respectively. Related to this probability is the outcome, e.g. the loss amount, which is usually referred to as the Value-at-Risk

(VaR). This is a term coming from the risk management of financial markets in the 1990s. One of the drawbacks of ruin probability and VaR is that those measures only specify one point on the distribution function, thereby neglecting valuable information. In particular, one is interested in what happens beyond the VaR, in other words, "How bad is bad?" Recent advances in extreme value theory enable us to provide more reliable answers to this question by bringing to light alternative measures, such as the expected shortfall. This involves quantifying the risk of events that can happen beyond a threshold probability, e.g. the ruin probability.

In Figure 1, we show an example of a real case where all possible outcomes are plotted with their respective probability. As described above, a risk measure attempts to synthesize the uncertainty of all possible outcomes described by the curve in a single number. The two most widely used measures are standard deviation and the 99^{th} percentile. The latter value has become very popular in the financial risk management community as Value-at-Risk (VaR), giving the size of the loss. In insurance, one traditionally does not use the value, but rather the level, referred to as ruin probability. As it is not possible to do justice to the information on the whole distribution with one number, any risk measure has its limitations.

Standard deviation is more appropriate when looking at year-to-year result fluctuations (smoothness), and percentiles are more helpful when determining what we intuitively associate with risk, namely the potential for large losses and very poor results.

Obvious shortcomings of the VaR as a risk measure are that it neglects the shape of the distribution below the 99^{th} percentile on the one hand, and the expected size of the losses above the 99^{th} percentile on the other hand.

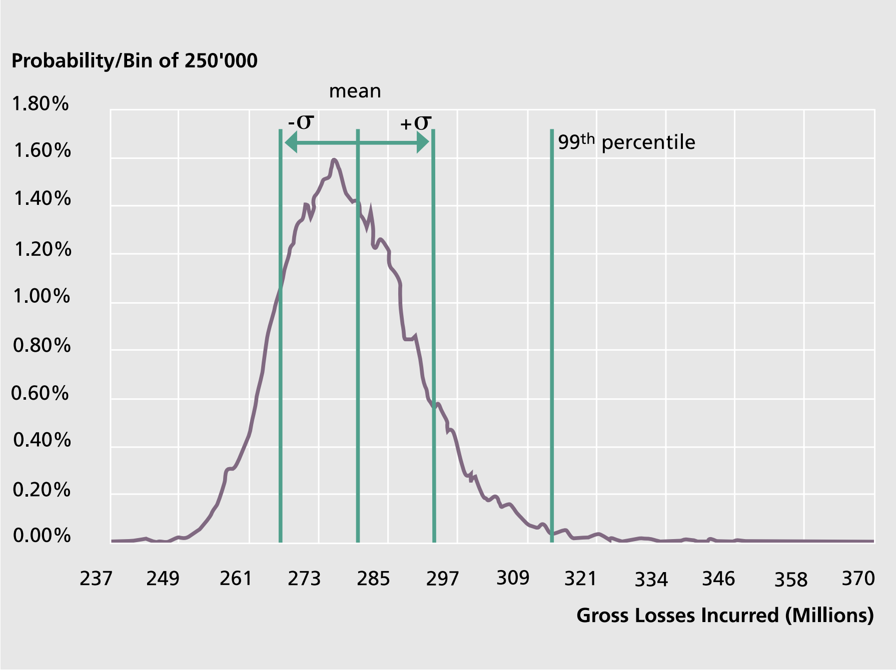
As when selecting an adequate measure for dispersion, there is some freedom when choosing a measure for characterizing the center of the distribution. We shall use the arithmetic mean in this study because its statistical properties make it the most suitable measure for insurance. We decided to use VaR as the risk measure in this document, as it is the most popular approach and is well accepted by risk managers.

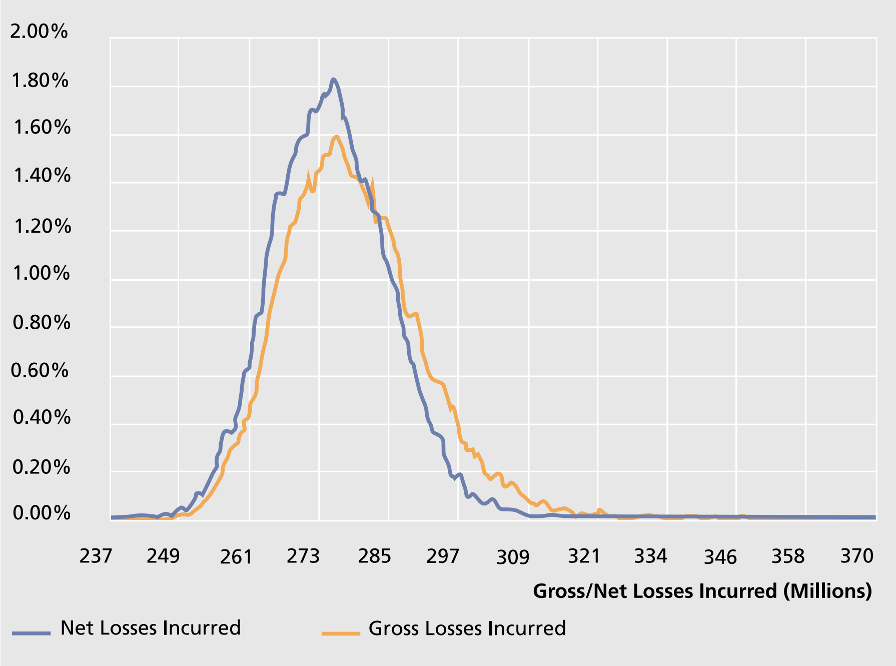
The Case

The examples shown beside describe the results of an actual study conducted for a primary insurance company. The numbers and names have been altered. The company is primarily a personal lines insurer with a well-balanced portfolio of 6 lines of business. The reinsurance program presently in force is presented in figure 1.

The total assets of the company amount to around 1.5 billion and the reported equity is 225 million. In this particular case, applied to the cedent's portfolio, that means the company's retention is 6.6% of equity for natural catastrophes and 1.1% per risk for liability and marine, but 2.2% per risk for property and accident.

Figure 1





Probability distribution of the losses incurred for the sample portfolio as calculated with the statistical model described later in the text. The figure above shows the mean, standard deviation(s) and the 99th percentile. The figure below illustrates the difference between the gross and the net loss distribution due to the current reinsurance program.

Risk Reduction by the Current Reinsurance Program

In Figure 2 we show both the risk gross and net of reinsurance as determined by a quantitative (simulation) model. We will discuss in a later section how such a model can be established based on loss history and exposure data. The blue bars represent the size of the downside deviation of the underwriting result from the expected underwriting result occurring once in 100 years[1].

- What may be surprising is that this once-in-100-years deviation of the losses is many times higher than the retention. According to the program, shouldn't the reinsurer pay the large losses? The reason lies in the frequency. An exceptional accumulation of losses just below the attachment point of the excess of loss treaties can add up to a large loss in one year.
- For some of the lines of business, the net risk (light blue bars) is almost equal to the gross risk of other lines (dark blue bars). This poses the question whether it is actually necessary to purchase the reinsurance for the lines with the low gross risk. Would it not be more effective to spend the reinsurance dollars on reducing the risk of lines with higher exposures?
- We also see the diversification potential of the portfolio: The sum of the 99th percentiles of the gross results is 100, while the 99th percentile of the gross portfolio is 36, relatively close to the square root of the sum of the squares[2]. Does the reinsurance make efficient use of this diversification potential? We will come back to this question later.

Table 1: Current Reinsurance Program.

	Premium	Proportional	Per risk XL	Per event XL
Property	65 M	Surplus: 6 Lines with a retention of 10 M	5 M xs 5 M	15 M xs 15 M
Motor Liability	71 M		From 2.5 M to unlimited	
Motor Hull	78 M			25 M xs 5 M
General Liability	28 M		37.5 M xs 2.5 M	
Marine	58 M		32.5 M xs 2.5 M	15 M xs 15 M
Personal Accident	131 M		5 M xs 5 M	

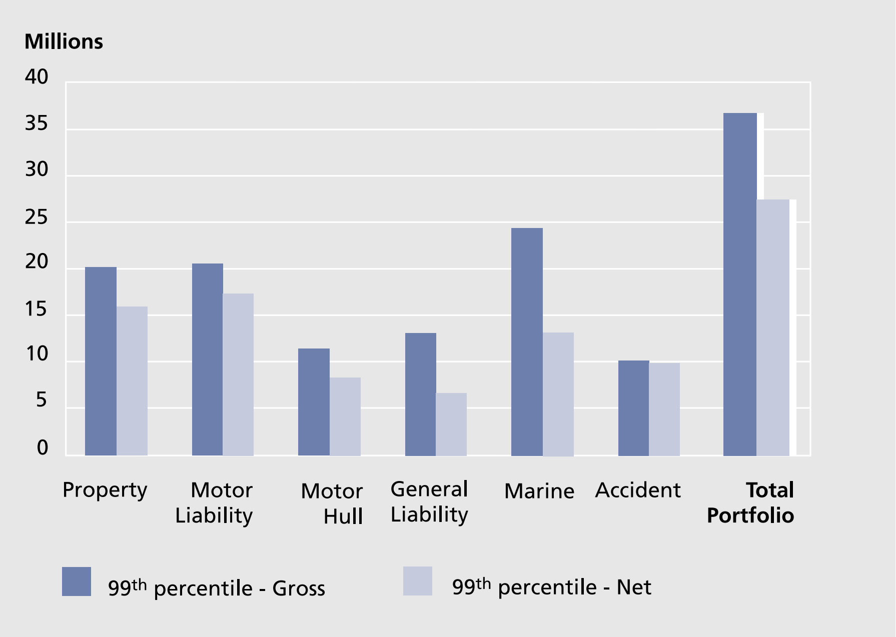
1
Technically speaking, it is the difference between the mean and the 99th percentile of the distribution of the underwriting result.

2
If the individual loss distributions were Gaussian and not correlated, the square root of the sum of the squares would equal the 99th percentile of the total portfolio. The above example indicates that there is indeed a diversification effect, which can be exploited.

- If we compare the 99th percentile risk to the company equity and the expected underwriting results, we see that with 1% probability the total portfolio will fall short of the expected underwriting result by 36 million, or 16% of equity. The current reinsurance program reduces this risk to 27 million, or 12% of equity. In terms of loss ratio, the 100-year "surprise" is an 8.4% gross, and 6.3% net, impact.

Whether these results are acceptable depends on the risk tolerance of the company, its financial strength and return targets. The present program does not seem to help increase the balance between the lines of business very well, but perhaps this only reflects opportunistic reinsurance purchasing? Before returning to these questions, we shall first have a look at our second measure of risk, the standard deviation of the underwriting result.

Figure 2



The dark blue bars represent the risk for each line of business as measured by the size of the unexpected downside deviation in 1 out of 100 cases (99th percentile) from the expected underwriting result (the mean). The retained risk (net of reinsurance) is shown by the light blue bars. The last two bars on the right of the graph visualize the total portfolio risk, both gross and net.

At this point we should mention that a full analysis of the portfolio would include possible other factors of deterioration of the results, both in frequency and severity, such as changes in economic habits, in legislation and court decisions, risk of economic recession as well as social/economic inflation or increased market pressure to reduce premiums. These are not taken into account here. However, we have developed economic scenario generators that could be used to allow for these considerations in the models, but these are omitted in this study for ease of understanding.

In Figure 3, the standard deviation of the gross and net underwriting result is presented for each line of business. As can be expected for a program that is dominated by non-proportional treaties, the smoothing effect is small on the standard deviation, but much bigger on reducing the VaR:

- The current structure reduces the tails of the loss distribution, as measured by the 1% percentile, from 36 million to 27 million, or by 25%. The yearly fluctuation as measured by the standard deviation, however, is reduced by only 17.7% (from 13.25 M to 10.9 M).

- As before, all lines of business are protected, including those that do not seem to need a cover in view of their relatively small risk compared to the other lines.

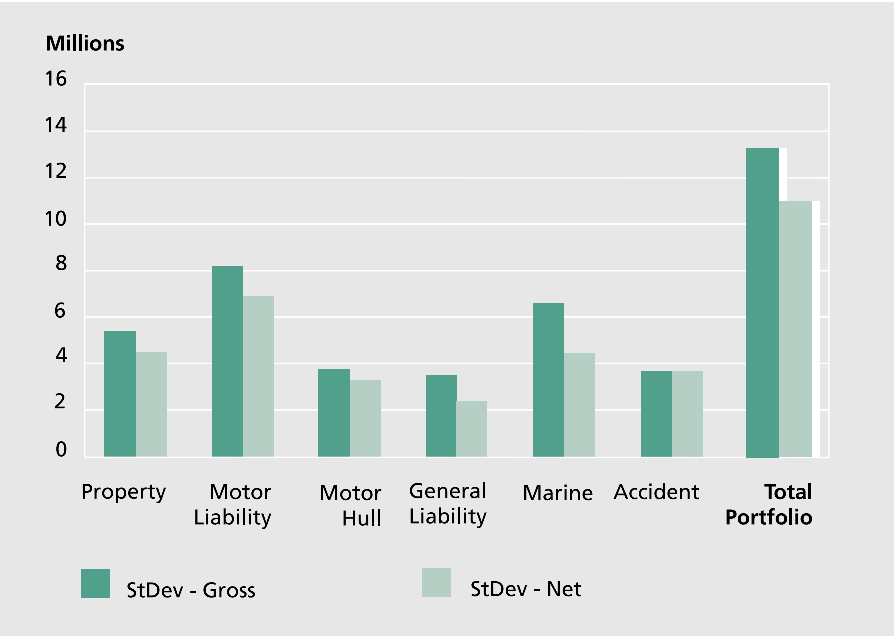
We conclude for the moment that the statistical model has made it possible to measure the underwriting risk. But what does this tell us? We turn to this question now by viewing risk and reinsurance from a more financial perspective.

How Much Reinsurance Do You Need?

In this Section we review the Trade-off between using Capital and buying Reinsurance.

The objectives of reinsurance should be stated in quantities related to the company balance sheet and profit/loss account, rather than to the loss potential of single risks or single events, as we have seen. The first question to be answered is how much capital a company is willing to risk within a given time horizon (normally one year). With the answer to this question the appropriate reinsurance cover can be determined, including the actual retention. In other words: we trade reinsurance against capital.

Figure 3



Standard deviation of the one year underwriting result by line of business. The dark green bars represent the variation of the gross result, the light green bars the fluctuations of the net underwriting result.

It is helpful to clearly distinguish between the capital an insurance company actually has on its balance sheet, i.e. *the face capital,* and the minimal amount of capital it would need in order to cover the risk it has taken. The capital really available is the capital reported in the equity section of the balance sheet, plus the discount in the reserves and unrealized capital gains from investments (plus other hidden reserves, if any). This is usually referred to as the *economic capital.* In case capital gains or reserve discounts are realized, they flow through the income statement and create a tax liability, so this additional capital needs to be adjusted for latent taxes. We shall call this capital: the *economically adjusted capital* (EAC).

Finally, the *risk-based capital* (RBC) is the capital required to cover the risk the company takes. It is derived from the evaluation of the different risks. It is the virtual amount of capital that needs to be covered by the asset side of the balance sheet (Figure 4).

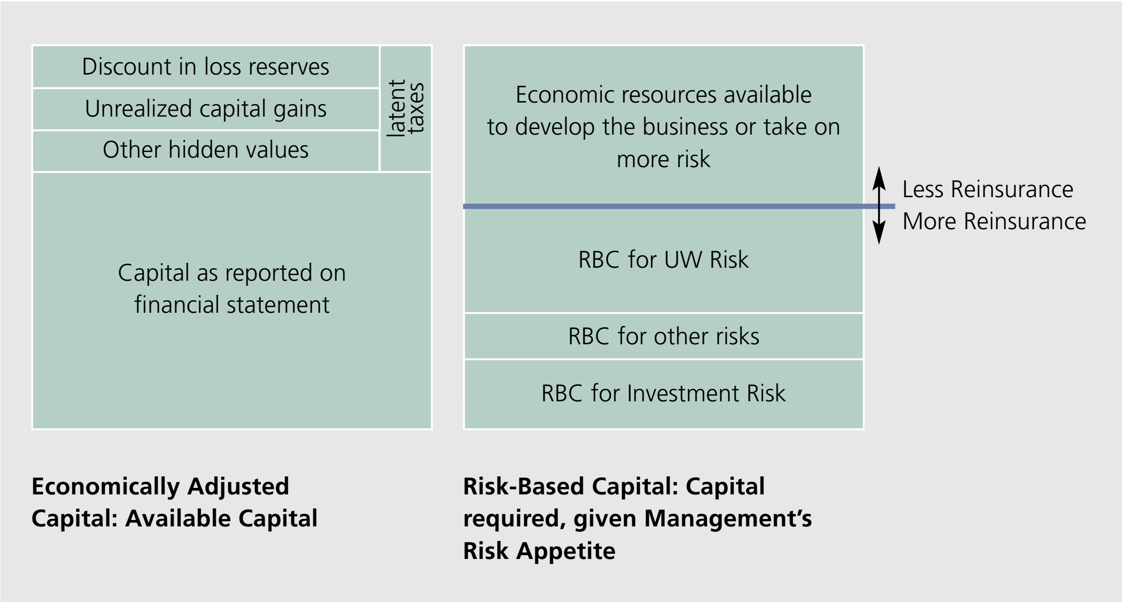
Since there is no unique way to define RBC but rather many possible ways, the definition of RBC reflects the risk tolerance of the company and the way management gauges risk. One possible choice is to say, "The RBC should only be lost once in a hundred years." Since this is a widely accepted definition, we will use it in the remainder of this document. It is important to keep in mind that capital allocation is a useful concept, but that the split is arbitrary[3].

3
Once it is formulated it is no longer arbitrary. But the choice of the method is purely a matter of weighing the pros and cons of the various options and is dependent on the risk attitude of the management.

What Happens to the Risk-Based Capital when the Company Purchases More Reinsurance?

First of all, reinsurance comes at a cost and reduces risk. But it also frees up risk-based capital because the loss potential has been reduced. Since the risk-based capital is part of the shareholders' funds, the cost of equity charged for underwriting risk has also been reduced. The value proposition of the reinsurer states the following:

Figure 4



The capital of an insurance company. Left section: real capital available; right section: theoretical allocation of the real capital to its various uses.

Due to the diversification ability of the reinsurer, more capital is freed up on the cedent's side than is bound on the reinsurer's side. Therefore, the cost of assuming the risk is lower for the reinsurer than for the cedent.

What Does it Help in Real Terms if RBC is Reduced?

It means that the cedent can take on more risk in other areas where the rewards may be higher, effectively creating value. Capital not bound to bear risk can also be used for developing and expanding the business, or can be given back to the owners via a share buyback program, for instance.

- An increase in the level of reinsurance *without* a change in the business or investment strategy shifts the risk level of the company down and comes at a cost (or vice versa): higher risk and higher return or lower risk and lower return.

- A change in reinsurance together *with* an appropriate change in the use of risk capital for other purposes like investments can create economic value: more return at the same risk level or same return at less risk.

In the next section we will compare the cost of reinsurance to the cost of capital to determine whether the value proposition of reinsurance holds in our example for the existing reinsurance cover. If reinsurance is more economical than using one's capital, the company would then be better off making use of the saved RBC for promising investments in its own business or in other companies.

Know What You Want

If reinsurance is to be used as a tool to stabilize and/or improve financial results, its objectives and the acceptable level of risk should be stated in terms of items on the balance sheet or the profit/loss accounts. The estimation of the probability of the underwriting results, or the net income, requires the development of adequate models. But even with the existence of adequate models it poses a real challenge to most people (including the authors) to come to a decision by looking at the gross and net underwriting result distributions for various reinsurance programs. Choosing the measures of risk (dispersion) and return (mean) which crystallize distributions into single numbers that most closely reflect management's intention is crucial in obtaining the structures best suited for the specific situation.

For our case study, we shall assume that the company's objectives are the following:

- The company feels comfortable with the overall risk it currently retains, but management is concerned by recent frequent losses that occurred just below the attachment point of the reinsurance covers. This fact has induced unwanted yearly fluctuations in the results.
- Because of the growth in the portfolio and increased financial strength, management would like to fully exploit the diversification within the portfolio and reduce the percentage of ceded premium.
- The company is wondering whether it would be cost-efficient to employ more capital to take on risk.
- Exploiting opportunities in the market place: Which reinsurance covers are expensive, which ones cheap?
- To measure risk, the 99th percentile of the downside variation of the underwriting result is used.
- Capital is allocated proportional to the 99th percentile.
- Risk tolerance: Management decides to expose about 15% of the current reported equity to total underwriting risk at the 100-year level. This number is not considered as written in stone but rather as a guideline and is derived from the expectation of a softening market, the asset allocation and a reserve review. The intention is not to increase the risk to a level at which it would be noticed by policyholders and shareholders.
- To measure fluctuations, we employ the standard deviation of the underwriting result distribution.

Build a Model

Now that the objectives have been formulated, it is time to build a model to quantify risk and assess the impact of a given reinsurance program. In the following, we will limit ourselves to the modelling of the underwriting risk. It is the component of the company risk on which the reinsurance program has the most direct impact.

The basic statistical model for the losses incurred distinguishes three classes of losses:

- Catastrophic losses involving multiple risks. Ideally, a long history of losses is available separately for each peril. Such a history would allow determination of an empirical frequency and severity distributions through statistical methods, taking into account the changing exposures as well as the inflation. Moreover, for many regions and perils there exist fairly reliable exposure-based natural catastrophe models. Combining exposure models with actual loss history for a company generally yields the best results.
- Large losses from single risks. For each line of business, the history of large losses above a certain threshold (for example 50% of the retention) is studied and again a statistical model describing the frequency and severity is fitted. Inflation, changes in exposure and legislation, etc. must be taken into account as fully as possible. Especially for long tail lines[4] of business this process is delicate, and a significant amount of expert judgment will be required.
- CAT losses and large losses must be modelled event by event because potential reinsurance recoveries depend on actual claim sizes. Everything else goes into what we call attritional losses and may be modelled by a loss ratio distribution for each line or sub-line of business and currency in the simplest case.

Each loss also has an associated payment pattern, which determines when the actual cash payments are expected to occur. Such payment patterns may be held constant (static) or it may be helpful to construct a stochastic model in certain cases to reflect the uncertainty of the outcome.

Projected premiums and their earning patterns, as well as the potential to fall short on the projected premium growth, are necessary. Premium volume should be linked to the exposure in the model.

Many of the lines written by a company are correlated both in premium growth and on the loss side. It is thus essential to include such dependencies in the model. In particular, this approach allows for explicitly relating premiums and losses to their economic drivers. There are numerous approaches to dealing with this issue and it needs careful consideration; however, that is beyond the scope of this study.

Once the quantitative description is established, the gross and net loss distributions can be simulated with an appropriate simulation program. There are a variety of software tools on the market serving a wide spectrum of needs.

Determine the Risk and the Capital Needed to Support the Risk

Now that we have a model at hand, it is a straightforward matter to determine the risk. As stated in the objectives in step one, risk is measured as the 99^{th} percentile of the downside deviation of the underwriting result, and that is exactly what was shown in Figures 1 and 2. These numbers also represent the risk-based capital that would be needed if each line of business would be treated separately.

4
Long tail means that the claims are usually paid over a long period of time and the ultimate value can be difficult to estimate.

Calculate the Cost of Capital and Evaluate Reinsurance Market Prices

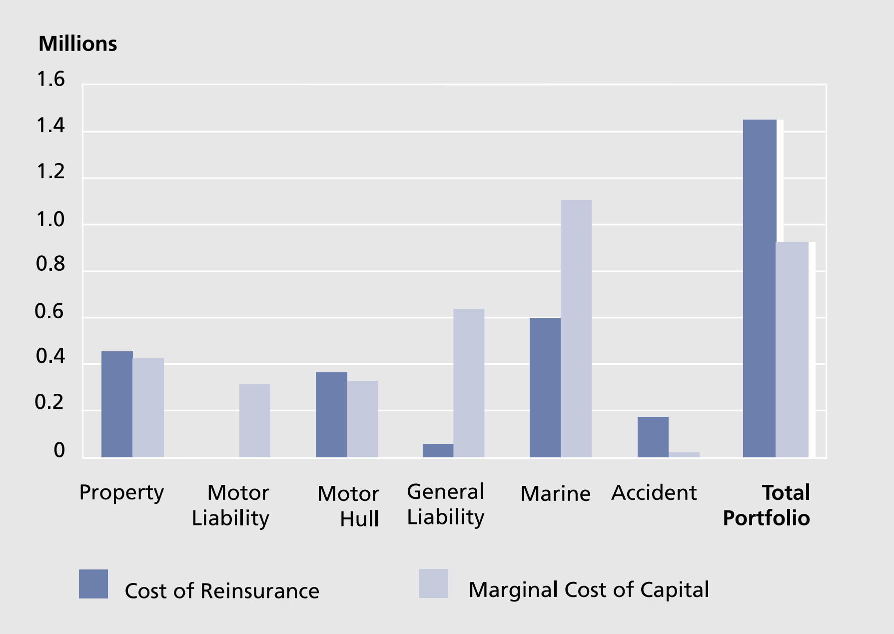
What is the price for providing capital (cost of equity)? It is the return the shareholders expect on their investment. One traditional way to estimate this cost of equity is the capital asset pricing model (CAPM), which states that the investor expects a risk premium above the risk-free rate that is related to the overall market return and the diversification effect of the investment: $r = r_{risk\text{-}free} + \beta\,(r_{market} - r_{risk\text{-}free})$

where $r_{risk\text{-}free}$ stands for the risk-free interest rate, r_{market} is the expected equity market return and β represents the dependency of the company's stock return on the market return. Insurance companies typically have a β close to 1. Obviously, the less correlated the investment is with the market, the less risk premium is needed.

Both the risk-free rate and the market risk premium change from country to country and depend on the general economic conditions and market volatility. We assume in the following that the changes in the reinsurance program we are considering are not of a magnitude that would be perceived by investors as a significant change in risk, so that the cost of equity is not different for that reason.

Since the risk capital of an insurance company is invested and bears interest, the true cost of using equity as risk capital is the difference between the cost of equity and the return on the company's investments.

Figure 5



Cost of reinsurance versus marginal cost of capital. The definitions of both are explained in the text. While it is more cost-efficient to employ reinsurance to cover the risk when each line of business is viewed as a separate entity, the cost of capital is significantly less than the total cost of reinsurance on a portfolio basis.

In Figure 5 we show for each line of business (viewed as independent) and for the total portfolio both the effective cost of reinsurance and the corresponding cost of risk capital. The effective cost of reinsurance is determined as reinsurance premium minus expected recoveries minus commissions received plus expected reinstatement premiums, all of these numbers being determined from the simulation with the described statistical model. Cost of risk capital in the figure was determined along the lines described above as cost of equity minus average investment return achieved by the company. Both are measured on the basis of an allocation of risk-based capital according to the 99th percentile of the downside deviation of the underwriting result. The light blue bars in the graph therefore represent the cost of the *difference* of the risk-adjusted capital for the gross and for the net business, which is called the marginal cost of risk-based capital.

First we notice in this figure that for the total portfolio the reinsurance is more expensive than it would be to employ a corresponding amount of risk capital. But at the same time we see the opposite applies for motor liability, general liability and marine. This is again a manifestation of the portfolio effect. While the effective cost of reinsurance for the total portfolio is simply the sum of the costs of the individual lines, the marginal cost of capital is much lower than the sum of the contributions. In fact, it is even lower than the largest single contribution[5]!

Secondly, the figure provides a way to gauge how much the risk reduction effectively costs in relation to the amount of risk transferred, since the dark bar represents the cost and the light bar is a measure for the risk.

5
This may seem surprising at first glance. But remember that we are looking at the marginal capital, which is the difference between the 99th percentiles of two distributions, and not directly at the percentiles themselves. Clearly the 99th percentile of the underwriting profit distribution of the portfolio is larger than the corresponding percentile of single lines of business (see Figure 2).

For motor liability, the graph indicates that the expected recoveries under the reinsurance agreement are actually larger than the premium paid (the cost is below zero), indicating a very competitively priced reinsurance contract.

General liability and marine both show what is expected from the classical value proposition of reinsurance: The reinsurance is less expensive than to put up risk capital because of the greater diversification in the portfolio of the reinsurer.

Interestingly, as we have just seen, this does not hold true when the total portfolio is considered. In short, for the declared risk tolerance (and the implied way the capital is allocated) the company does not fully exploit the diversification in its own portfolio but gives this benefit away. The added value of our approach is therefore that it allows us to look at the overall performance of the portfolio and evaluate how much the diversification effect should influence the reinsurance decision.

Other alternatives can now be considered: What if the company had chosen a different risk tolerance level; what if it had opted to allocate risk capital commensurate with the 99.9th percentile? The answer to this question is illustrated in the next figure (Figure 6), where the expected underwriting result is shown, including the cost of the allocated risk capital, before and after applying the costs and benefits of reinsurance.

Figure 6

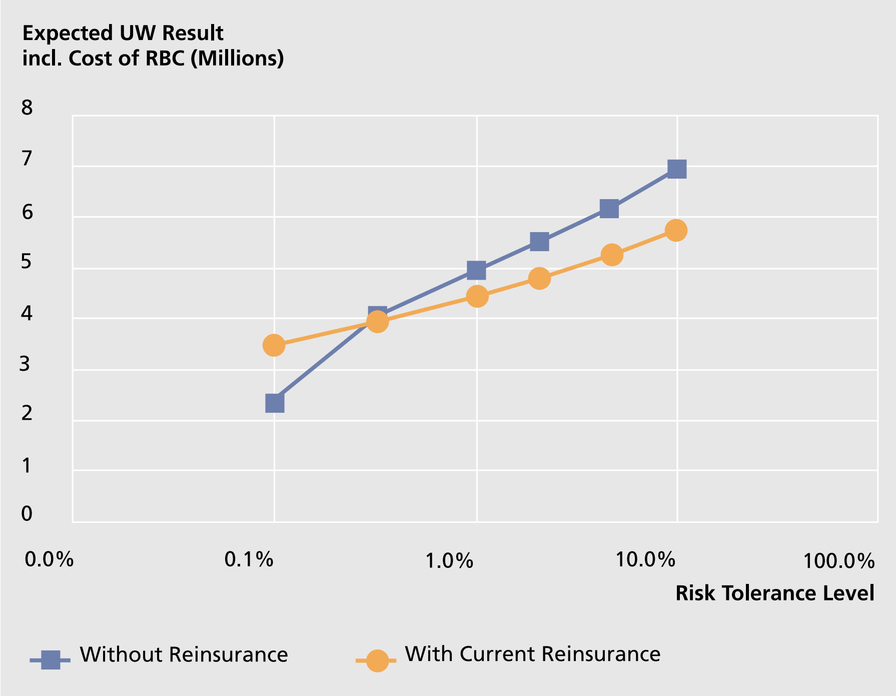


Illustration of the reinsurance-RBC trade-off. For high levels of tolerance to risk, it is more cost-efficient to bear the risk with additional capital; conversely, for risk-averse companies, it pays off to buy a significant amount of reinsurance.

We see that the current reinsurance cover is beneficial for risk tolerances below the 0.4% level, is neutral at that level but is not cost-efficient above. The graph reflects the common wisdom that a risk-prone company should buy less reinsurance than a risk-averse company.

Improve the Structure

Comparing the findings from the simulations and the earlier stated reinsurance objectives, we see that there is room for improvement:

- The company currently buys too much reinsurance overall relative to its risk tolerance level. There is a large amount of economically adjusted capital, which is presently "unused" and thus is available for use as risk capital.
- In terms of smoothing annual underwriting results, the current structure is still inefficient because of its excess of loss character. Further improvements in this direction can be achieved through the use of alternative or finite risk transfer mechanisms.
- There is unused diversification potential in the portfolio.

The following strategy is the direct consequence of these observations:

- Reduce the amount of XL capacity for the lines where the reinsurance is not capital-efficient. Take more risk in each sector – the impact on the overall portfolio will be very small.
- Exploit the diversification that is inherent in the portfolio by combining reinsurance covers from various lines of business into a single contract.
- Smooth yearly results using a multi-year contract with properly engineered risk-transfer and financial characteristics.

When implementing this strategy, it is imperative to work out a few different possibilities and to test their acceptance by the market. For the following, let us focus on one particular structure:

Risk Transfer

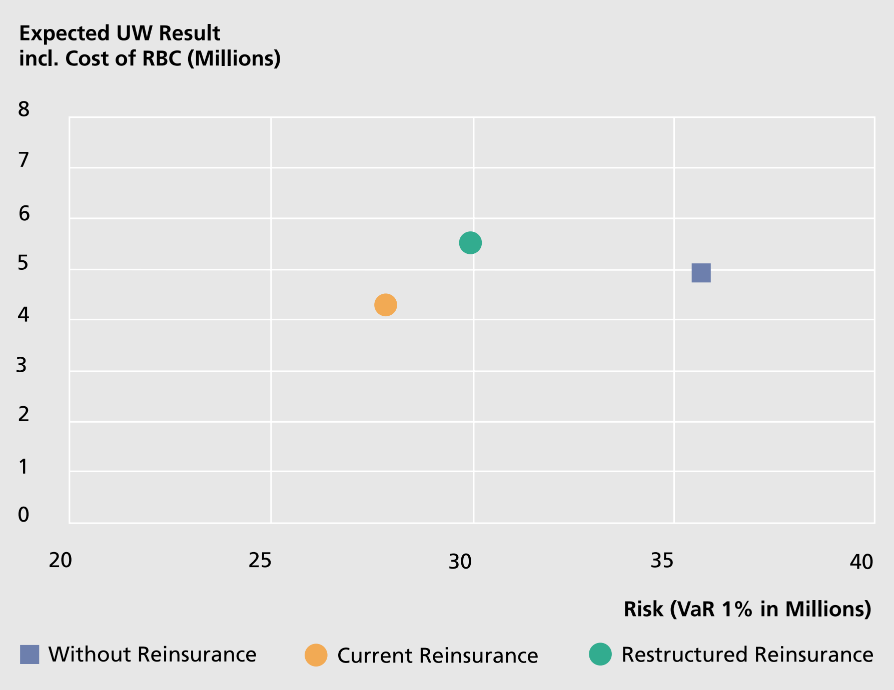
- Natural catastrophes: Increase retention to 30 million for the motor hull CAT cover. This cover does not significantly reduce the portfolio risk, but has a relatively high cost.

- Combine the CAT covers (property, motor hull and marine) into one contract or reduce the capacity and reinstatements of each contract and add a top & drop layer. This effectively transfers a part of the diversification benefit from the reinsurer to the cedent.

- Add an additional layer at the lower end in motor liability if the conditions are as good for this as for the higher layers (buy where the market is cheap). This would reflect opportunistic behavior exploiting market inefficiencies.

- The accident reinsurance cover seems of no benefit. It may be dropped, unless there are other factors not reflected in the model which make it desirable (uncertainty about future changes in the legal system, parameter risk in the model, know-how transfer from the reinsurer, etc.).

Figure 7



Risk versus return. The return is measured as the expected underwriting result including the cost of the necessary risk-adjusted capital.

Smoothing

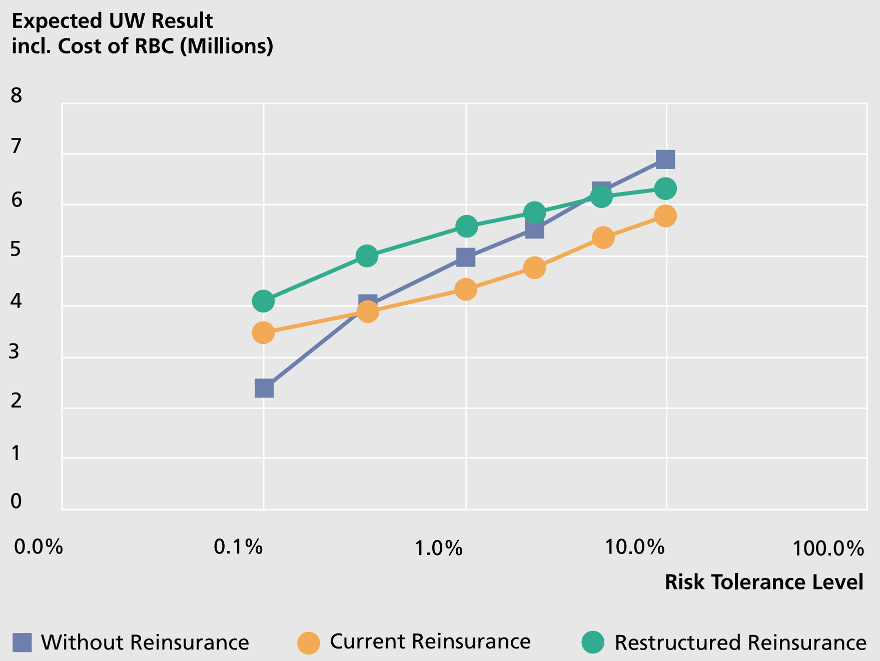
- An efficient smoothing of results is difficult to achieve with traditional reinsurance. A better option is to use the diversification across the time axis by means of a multi-year contract with a profit-sharing scheme. In the context of the present case, the possibilities range from a mostly self-funded multi-year contract for the CAT exposures below the XL attachment points to a full-fledged earnings-smoothing cover for the whole account. For the illustrations below we have not included this type of reinsurance, since we would typically have to look at multi-year development of the reinsurance market (hard versus soft markets).

The cumulative effect of the listed changes is shown in the following graphs. In Figure 7, the expected underwriting result (including the cost of the necessary risk-based capital) is plotted versus the risk as measured by the 1-percentile (VaR). The risk of the total portfolio has grown slightly with the new structure by an amount that is not significant when compared to the true amount of economically adjusted capital of the company. At the same time the expected net underwriting result is boosted thanks to the reduction in the necessary amount of risk-based capital and the overall reduction in effective reinsurance cost.

Given this result at the chosen risk tolerance level of 1%, we now turn to the question of how sensitive this improvement is to the choice of the risk tolerance level. The answer is shown in Figure 8. The new structure outperforms the old one and the no-reinsurance strategy for risk tolerance levels below about 2%, and it outperforms the old structure for all risk tolerance levels.

What is the Final Message?

Figure 8



Comparison of the new and the old reinsurance structures.

Reinsurance is the appropriate tool to shape an insurer's net liability from a portfolio. To get the full benefit, the focus must shift from consideration of single risks or events to a portfolio view. Recent developments in statistical modelling and simulation in the field of reinsurance have reached a level at which it has become possible to take the portfolio perspective and truly understand the trade-offs between risk, capital and reinsurance.

We Can Assist You in this Process

What Can We Offer?

We believe that we can offer our clients a practical and workable approach to optimizing their use of traditional and non-traditional reinsurance in the context of their financial constraints. Both the reinsurance and equity questions should be addressed simultaneously for the most efficient use of the capital.

By leveraging the experience of our experts in traditional and non-traditional reinsurance, financial markets and modelling of natural catastrophes, we believe we are in a unique position to help our clients' management structures in their effort to find the right balance of capital and reinsurance to sustainably meet their financial goals.

Resources and Timescale

Just as data integrity and local knowledge are important for the model-building process, the availability of local resources is crucial for success. A direct contact between the company's experts (actuarial/financial) and our analysis team is essential.

Assuming full support from the company's management, the typical time frame for such a study is from six to eight weeks.

General Structure and Simulation Tools

We currently use separate commercial software platforms to conduct the business modelling and the stochastic simulation. These are generally the most advanced programs available on the market for structuring reinsurance, although we have also developed a number of additional components, which complete the capabilities of these standard programs. For smaller applications we have developed a proprietary software program called "ReStructure".

The general hierarchical structure of the quantitative model will reflect the organizational structure of the company. Each business unit has its own pro forma (virtual) financial statements (balance sheet, income statement and cash flow statement) for gauging the impact of the reinsurance on the local P&L accounts and performance measures. The local risk-based capital may be provided from other already defined sources, or we can elaborate a proposal for an economically fair RBC for each local unit based on the exposure. In the actual method and formula we are not constrained and may implement many preferences, which would emerge in discussion with the company's management.

The model for each local business unit would then be further divided into the different lines of business and a premium and loss model created for each of these.

The purpose of a typical study is manifold:

- Determine the underwriting risk and the effectiveness of the current reinsurance cover. Measure the needs for risk-adjusted capital and determine optimal reinsurance-RBC trade-off.

- Optimize the reinsurance structure by determining the best retention level, using the full diversification potential of the portfolio.

- Determine expected financial performance for a number of different reinsurance structures.

- Measure the added economic value.

Natural Catastrophes

Important parts of any such model include scenarios for windstorms, hail and earthquakes. It is most often advantageous to make use of pre-existing models from the client's risk management.

We routinely use Catrader (AIR) and Risklink (RMS) for the simulation of windstorms and earthquakes. Our team of experts in the natural catastrophes area has a vast experience in using these models and calibrating them. We have developed our own proprietary models for many perils/regions. For example, we have developed a proprietary program to estimate hailstorm losses, which we have used repeatedly in consulting for our clients in France. Using this program together with actual loss experience, we are able to create a realistic set of scenarios of hailstorms. It must be noted, however, that uncertainty in the modelling of hail is generally accepted to be higher than for windstorms.

Reserves and Assets

Although it is not absolutely necessary to include the reserving risk and asset risk in a model, depending on the lines of business, it can add much value.

Data Requirements

The following is a list of required data for such a study. As each company has different ways of storing historical information, it has been kept very general and is intended as a guideline.

For each line of business or product to be modelled separately, one should have:

- Gross premium, net premium, costs – both written and earned.

- For surplus treaties: Risk profiles.

- Losses incurred and paid, split by

  – Large single losses (single risks/policies), "large" meaning exceeding about half the attachment point of the lowest XL layer. Triangles for incurred and paid.

  – CAT losses: Everything that has involved multiple risks/policies, even if the "CAT" losses are small. Triangles for incurred and paid.

  – Attritional losses. Triangles for incurred and paid.

- Exposure data for CAT models.

- History of rate changes.

- History of changes in business mix, changes in laws, etc.

And for the whole company:

- Financial statements extending back several years, to place the reinsurance in a financial context.

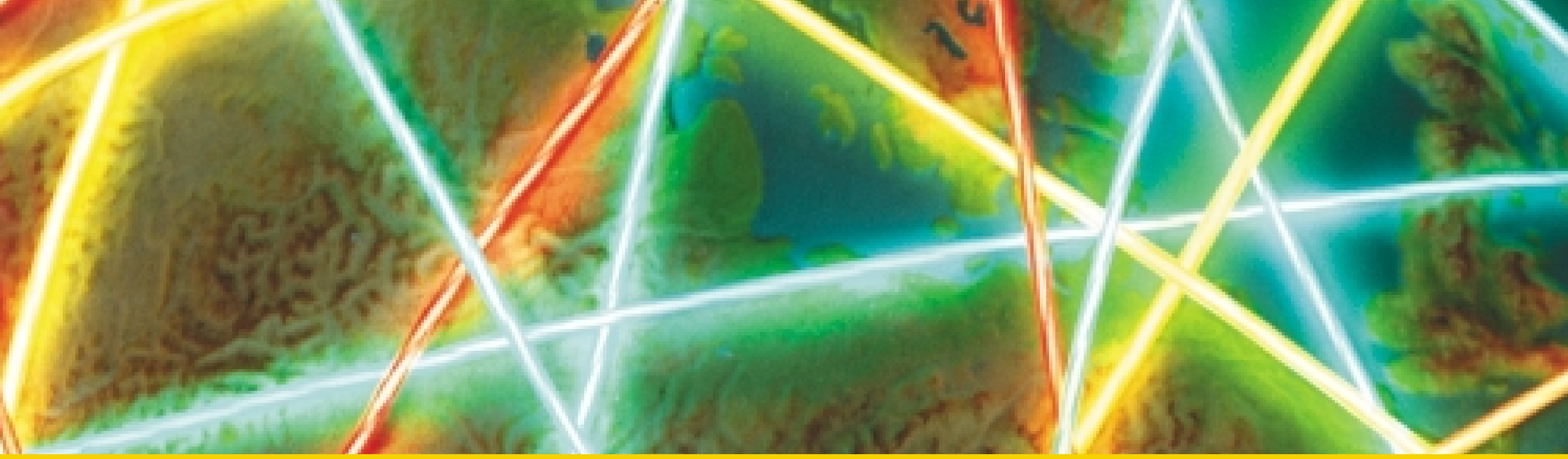
- Business plan for next year, containing expected development in premiums, losses, costs and reserves.

Conclusions

We have presented in this case study a consistent way of quantitatively assessing the impact of a reinsurance program on a company's risk exposure and financial results. The use of a model helps in understanding the trade-off between risk-based capital and reinsurance, thus providing new insights into the business. As a result, we are able to design an improved reinsurance structure, which makes efficient use of the available capital and increases the expected financial results.

We believe that in tomorrow's capital markets it will become even more important than it is today to allocate resources to their most promising use. Clearly, the approach presented here is not the only consideration to take into account when deciding on the appropriate reinsurance cover. For example, one could put more or less emphasis on the long-term advantage of preserving the stability of the returns that a good reinsurance program can provide.

The discussion on this subject will continue. Nevertheless the method presented gives a general framework for working towards a better use of reinsurance to the benefit of both the cedent and the reinsurer.



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