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Solvency Consulting Knowledge Series

Impact of reinsurance on risk capital
A practical example

Solvency II obliges companies to take a risk-adequate view of their operations as a whole. Sample calculations for a specimen company using the standard model and a partial model show that reinsurance remains one of the simplest and most flexible ways for an insurer to manage its balance sheet.

Your contacts

Dr. Ali Majidi
Tel.: +49 (89) 38 91-39 23
E-mail: amajidi@munichre.com

Dr. Norbert Kuschel
Tel.: +49 (89) 38 91-43 49
E-mail: nkuschel@munichre.com

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The European Union's modernisation of solvency requirements in the insurance industry poses a major challenge to all insurance companies. The proposed standardised approaches for determining solvency are intended to result in a risk-adequate view of each insurer's overall situation, taking into account all risk drivers. But what does that mean for insurance companies in practice? What implications does the change from a rules-based calculation of solvency to a principles-based determination of capital requirements under Solvency II have for the available risk capital and how can the risk capital be reduced by means of reinsurance?

To date, these question have been discussed in a very theoretical way with reference to models and methods, a key role being played by quantitative impact studies (QISs). But what are the limits to the standard models with their restricted factors and fixed scenarios? Can stochastic models in particular help to precisely determine the impact of reinsurance on an insurance company's risk situation?

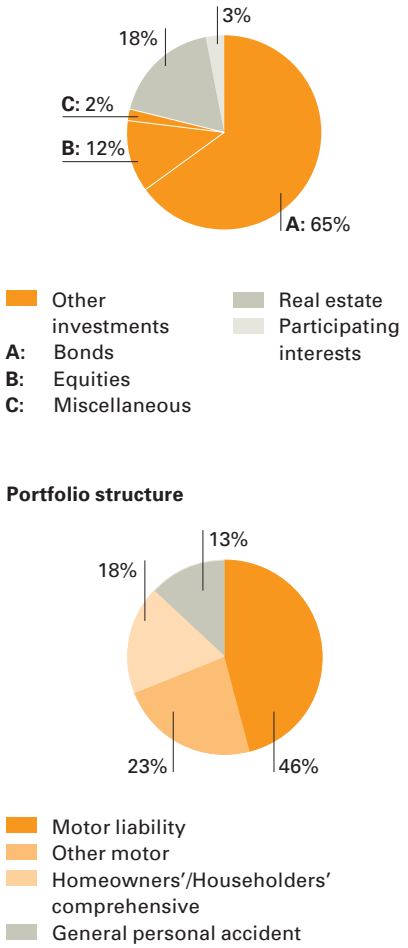
In investigating these questions, Munich Re's Solvency Consulting Team set itself the ambitious objective of creating transparency. Taking the balance sheet of a specimen company typical of the market, the experts calculated on the basis of concrete figures – firstly with the standard model and then with a stochastic partial model – the risk capital required if reinsurance is used. With great curiosity and determination, they analysed the complex interconnections and strove to make these as transparent as possible.

As of November 2008, the resultant portfolio data are being made publicly accessible on the Solvency II-Portal PillarOne (www.pillarone.org), initiated and sponsored by Munich Re, with a view to providing a clear basis for open discussion throughout the industry.

The specimen company: Medium-sized property-casualty insurer

In modelling the specimen company, the experts took account of the wide range of possible study parameters, especially as regards the impact of reinsurance. Consequently, ten-year historical data from various lines of business with different settlement patterns were used for the modelling (see Fig. 1).

Fig. 1 Investment and portfolio structure of the specimen company



Typical property-casualty insurer with various lines of business.

Further assumptions were that the company's historical results are average for the German insurance market as a whole and that past major loss events were dominated by property business in particular. Key among these events were natural catastrophes in the financial years 2002 (flooding) and 2007 (Kyrill). At 99.95%, the specimen company's planned combined ratio for the current financial year 2008 means that it just achieves an underwriting profit.

The specimen company's investments are characterised by a very conservative investment strategy, reflected in a high proportion of EU government bonds. Its percentage of investments in equities is 12.1%. Total investments amount to €314m, with €56m invested in real estate, €9m in participating interests, and €249m in other investments. This breaks down in turn into €38m invested in equities, €204m in bonds, and €7m in miscellaneous.

Premium income written by the specimen company shows the following split: €189m from motor liability, €97m from other motor business, €54m from general personal accident, and €73m from homeowners'/householders' comprehensive insurance. Its resultant commercial balance sheet is shown below:

Fig. 2 Specimen company's German GAAP balance sheet

Assets:	**€314m**
– Real estate	€56m
– Participating interests	€9m
– Other investments	€249m
Equity and liabilities:	**€314m**
– Equity	€112m
– Liabilities	€202m

According to the current Solvency I rules, these figures result in required solvency capital of €70m and equity capital of €112m for the specimen company. Under Solvency I, its solvency ratio is 160%.

The standard model

The guidelines and principles established by CEIOPS for solvency criteria under Solvency II place exacting demands on companies: the solvency criteria have to be precisely modelled and calibrated. The QISs are of assistance in this process, but the approach a company ultimately decides to use will depend strongly on the complexity of its business. At present, we can assume that several options will be possible under Solvency II. It is likely that frequently the (adjusted) standard formula will be used, with the adjustment taking the form of a reduction or calibration with the company's own data. If part-modules are to be stochastically modelled, a partial model is required. The precise modelling of all relevant risks necessitates an internal model certified by the supervisory authorities. In addition, companies will have to reckon with far-reaching consequences for data storage, accounting and IT infrastructure.

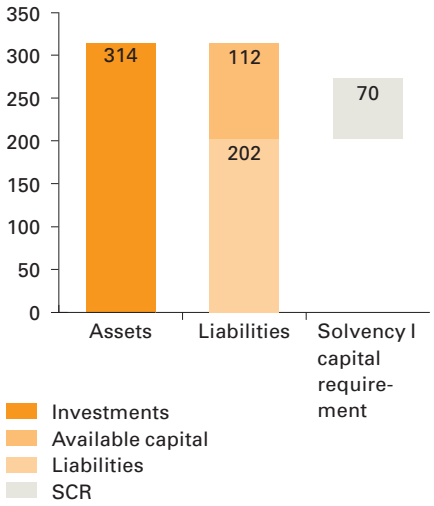
Model assumptions and risk measure
To calculate the solvency criteria according to CEIOPS, an economic balance sheet first needs to be prepared so as to determine the available capital. Following this, the solvency capital requirement (SCR) is calculated in order to arrive at the solvency measure according to Solvency II.

Determining the solvency measure
Assets and liabilities are recognised at market value in the solvency balance sheet. The following steps are necessary to determine the solvency measure:

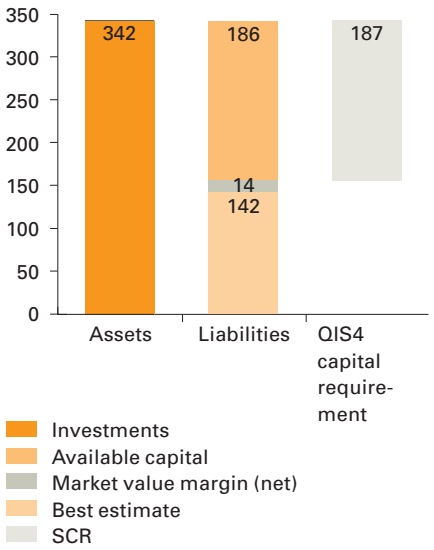
1. Value the portfolio actuarially: The associated cash flow is accounted for with a risk-free interest-rate curve at market value (as prescribed by CEIOPS).

Fig. 3 Statutory versus solvency balance sheet (€m)

Solvency I balance sheet



QIS4 balance sheet



2. Determine the "market value margin" (MVM: cost of capital for non-hedgeable risk capital). The outcome is the market-value balance sheet as per Fig 3. The item "market value margin" (i.e. the difference between the market value, the liabilities and the best estimate) in the market-value balance sheet enhances transparency with regard to the portfolio. Thus, for example, purely on the basis of this simple solvency measure from the balance sheet, it is possible to (roughly) estimate the "long-tail bias" of a company's portfolio.

3. Calculate the available capital from the market-value balance sheet. The result for the specimen company is that the available capital increases by €74m.

4. Determine the SCR and solvency ratio according to QIS4: The SCR can be broken down into various categories (see Fig. 4), with the category BSCR (basic solvency capital requirement) making up the main portion of financial and insurance risks. The BSCR can, in turn, be spit into the subcategories "non-life", "market", "health", "counterparty/default" and "life". For the specimen company, all types of risk except "life underwriting risk" have to be calculated. The analysis shows that underwriting is clearly the main driver of the dramatic increase in the SCR. If the new solvency regulations were already in force, this would result in supervisory action having to be taken.

Without reinsurance, the capital requirement rises to €187m if the standard model according to QIS4 is used. Given the existing equity capital of €186m, this results in a solvency ratio of 99%.

Impact of reinsurance

Since the risks from non-life (catastrophes) predominate, the SCR could be lowered primarily by reducing the underwriting risks. The solvency capital was calculated on the basis of the following four reinsurance programmes (see also Fig. 5):

– Peak risk cover (PeakRisk): Pure non-proportional cover with relatively high priorities in all classes of business
– Pure non-proportional cover (NP): Pure non-proportional cover with very low priorities in all classes of business
– ML quota share and NP cover (ML50+NP): Cession of quota share in motor liability to improve diversification, and protection of the retention with non-proportional reinsurance with a low priority, as well as pure non-proportional cover with low priorities in the other classes of business (as per NP)
– Quota shares and NP cover (ALL 50+NP): Cession of quota share in all classes of business, and protection of the retention with non-proportional reinsurance with a low priority (as per NP)

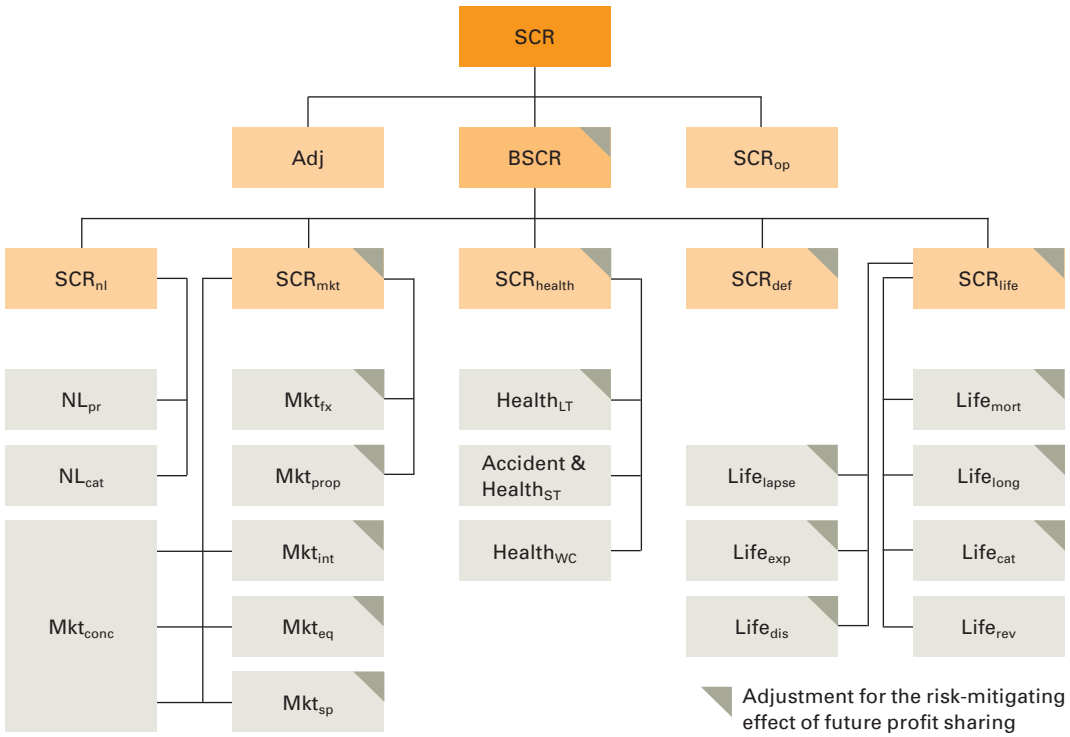
It is also assumed that the reinsurance programme has remained constant over the last ten years ("as-if" calculations), and that all scenarios are based on the same initial situation and the same available capital. Fig. 6 on page 5 shows the breakdown of the capital requirement according to individual risk components.

Table 1 Valuation of the assets and liabilities in the case of various insurance programmes (€m)

	Without RI	PeakRisk	NP	ML50+NP	ALL 50+NP
Solvency I					
Investments	314	314	313	307	304
Liabilities	202	202	201	195	192
Available capital	**112**	**112**	**112**	**112**	**112**
QIS4					
Assets	342	342	341	337	335
Reinsurance	0	0,02	7	54	74
Investments	342	342	334	283	261
Liabilities	156	156	155	151	149
Best estimate	142	142	142	142	142
Market value margin (net)	14	14	14	9	7
Available capital	**186**	**186**	**186**	**186**	**186**

Preparing the balance sheet: Step 1 in determining the solvency ratio with reinsurance.

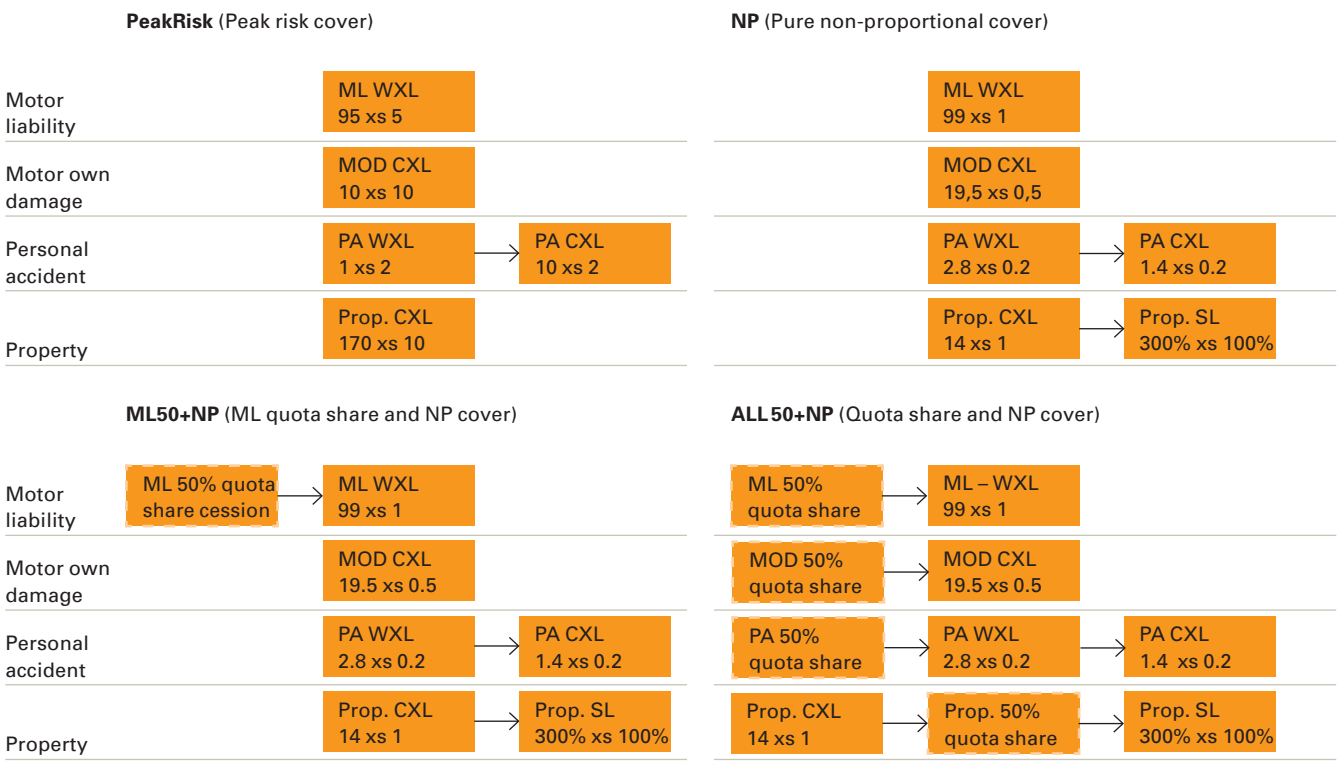
Fig. 4 QIS4 modular structure



Source: QIS4 Technical Specifications

Breakdown of the solvency capital requirement (SCR) under QIS4.

Fig. 5 The specimen company's individual reinsurance programmes (€m)



The solvency capital is calculated based on four different reinsurance programmes.

Determining the solvency ratio with reinsurance

1. Prepare the balance sheet: Table 1 shows the valuation of the assets and liabilities in the case of various reinsurance programmes. Under QIS4, the item "reinsurance" appears as an asset item in the balance sheet and therefore has to be recognised at market value. The value of the reinsurance asset depends strongly on the reinsurer's rating.

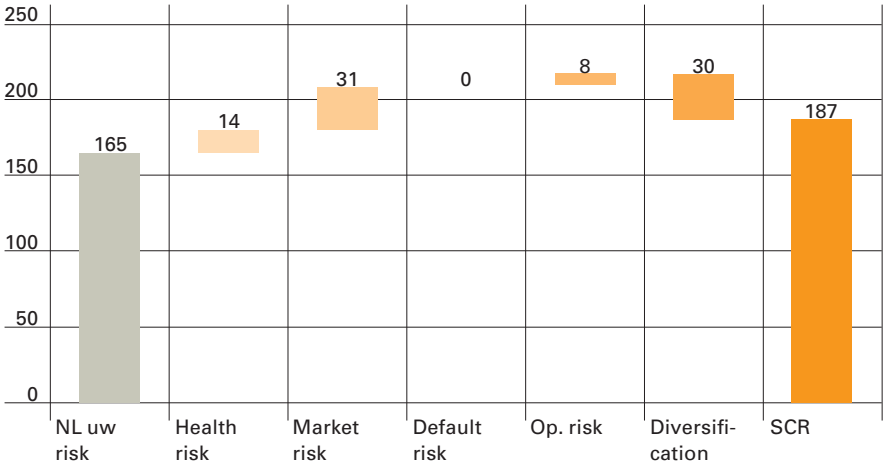
The liabilities in this balance sheet are recognised at the present value of the best estimate (before reinsurance), whilst the market value margins (calculated using the cost of capital approach) take reinsurance into account. Thus, for example, the MVM of the liabilities without reinsurance is €14m, whereas with the programme ALL 50+NP only €7m has to be recognised. For simplicity's sake, it is assumed that the reinsurer has an AA rating in each case.

2. Calculate the risk requirement under QIS4 for all programmes: Reinsurance has the effect of reducing the risk capital in every case. Fig. 7 shows that the reduction in the underwriting risk capital (SCRnl) impacts the overall SCR. Reinsurance reduces risk capital under the QIS4 system mainly via the change in the historical loss ratio and through the volumes of the respective lines of business (premiums or reserves). The system itself means that an adequate risk-reducing effect from XL treaties is difficult to realise.

Figs. 7 and 8 demonstrate a "model artefact" between the PeakRisk and NP programmes: although more risk is ceded in the NP programme, more risk capital needs to be provided. This model artefact is contrary to risk-sensitive capital requirements and prevents reinsurance being used to the full extent as an efficient capital management tool. Only the simplest standard products (quota share reinsurance and XL reinsurance) have been considered here. The individuality of the lines of insurance, their risk drivers and the lack of standardised structuring of reinsurance programmes point to the conclusion that it is difficult to realise an adequate modelling of underwriting and reinsurance in particular with the standard model.

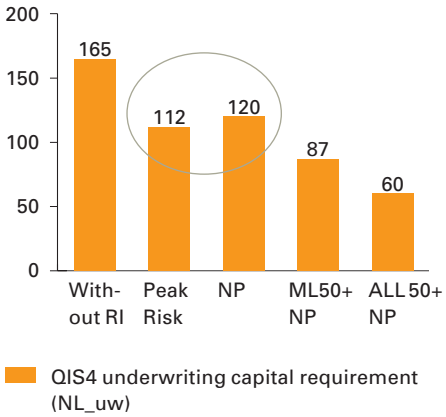
With reinsurance, the capital requirement sinks to only €81–143m, depending on the reinsurance programme. But artefacts prevent reinsurance being used to the full.

Fig. 6 Breakdown of the capital requirement according to individual risk components (€m)



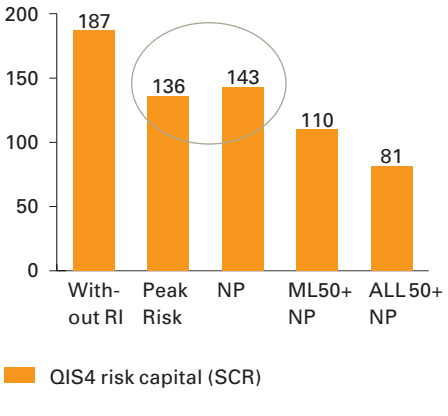
QIS4 risk capital (SRC) without reinsurance.

Fig. 7 Impact of reinsurance on overall risk capital (€m)



Step 2: Calculate the risk capital requirement under QIS4 for all programmes. Reinsurance has the effect of reducing the risk capital in every case.

Fig. 8 Impact of reinsurance on underwriting risk capital (€m)



"Model artefact" between the PeakRisk and NP programmes: although more risk is ceded in the NP programme, more risk capital needs to be provided.

Stochastic modelling

Underwriting risk is by some margin the main driver for the risk capital requirement in the non-life segment. This is shown by the results of the QIS3 benchmark study, concluded in mid-2007. Particularly in the non-life segment, reinsurance plays a central role in capital management. Partial modelling can be used to determine the risk measure and the impact of reinsurance on the risk capital. Several steps are necessary to develop and then calibrate such a stochastic model.

Calculating the risk capital requirement for the underwriting risk

1. Collect high-quality data: The better the data, the more informative the result. What is required is close integration of risk management in the company and a broad understanding of the relevance of the bases for the risk model.

2. Select and calibrate modelling methods: This step involves the identification of the risk factors, in which new products, a strong volatility, uncertainties in pricing, or increasing claims costs all play a part.

3. Simulate the portfolio: As from autumn 2008, the calculations of the specimen company can be accessed on the open-source platform PillarOne (www.pillarone.org), allowing companies to use a stochastic model.

4. Determine the distribution of aggregate losses: An important outcome of the simulation is the distribution of aggregate losses resulting for the whole portfolio and for all modelled lines of business.

5. Determine the distribution of aggregate losses after reinsurance: The risk capital can be calculated using different approaches and methods. In this example, the VaR (Value at Risk) approach was chosen consistent with Solvency II regulations. The factors used to calculate the required risk capital are the loss distribution, the expected value and the 99.5% quantile. With the VaR approach, the required risk capital is calculated as the difference between the 99.5% quantile and the expected value (Fig. 9).

The loss distributions of the individual lines of business and the aggregate loss distribution are now simulated. The results are used to determine the expected value and the 99.5% quantile (cf. Fig. 10):
– Expected value: €327m.
– 99.5% quantile: €460m.

Without reinsurance cover, the specimen company's risk capital requirement for the overall underwriting risk in the current financial year amounts to €133m.

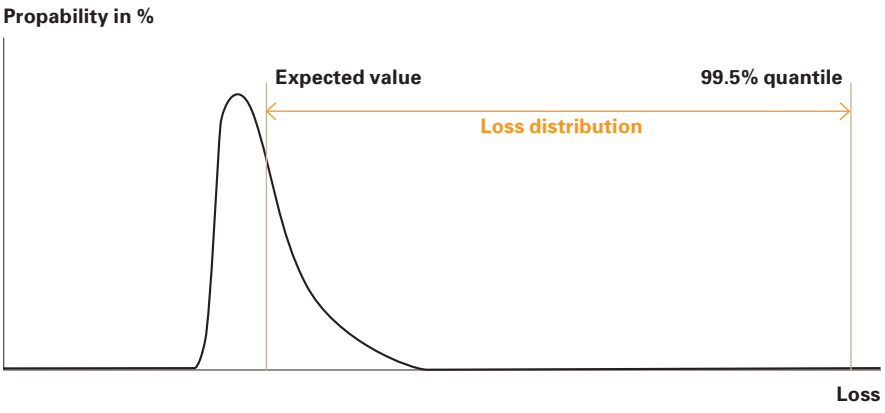
Impact of reinsurance

For the specimen company, the necessary risk capital was calculated for the reinsurance programmes PeakRisk, NP, ML50+NP und All 50+50. Fig. 11 shows the distribution of aggregate losses taking into account the reinsurance programmes.

On this basis, the risk capital for the PeakRisk reinsurance programme totals only €53m, equivalent to a reduction of €80m. The risk capital can be reduced still further – albeit to a very limited extent – by fixing low priorities. At €49m, the necessary risk capital for the NP programme is only €4m lower than in the case of the peak risk cover.

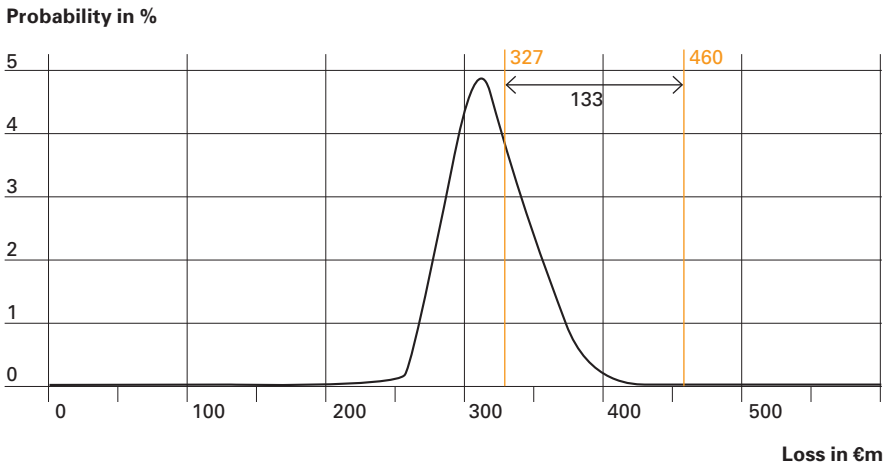
A further significant reduction in the risk capital requirement is again only possible through the use of proportional reinsurance. If, additionally, 50% of the motor liability business is reinsured using a quota share treaty, the risk capital can be reduced with the programme ML50+NP by a further €13m to €36m. The lowest risk capital of all four reinsurance programmes is needed if the whole portfolio is protected by quota share reinsurance with a retention of 50%, in turn protected by appropriate XL reinsurance. In the case of the ALL 50+NP reinsurance programme, the necessary risk capital amounts to only €24m – a reduction of €25m compared with the NP programme.

Fig. 9 Loss distribution with expected value, 99.5% quantile and risk capital



The required risk capital is calculated as the difference between the 99.5% quantile and the expected value.

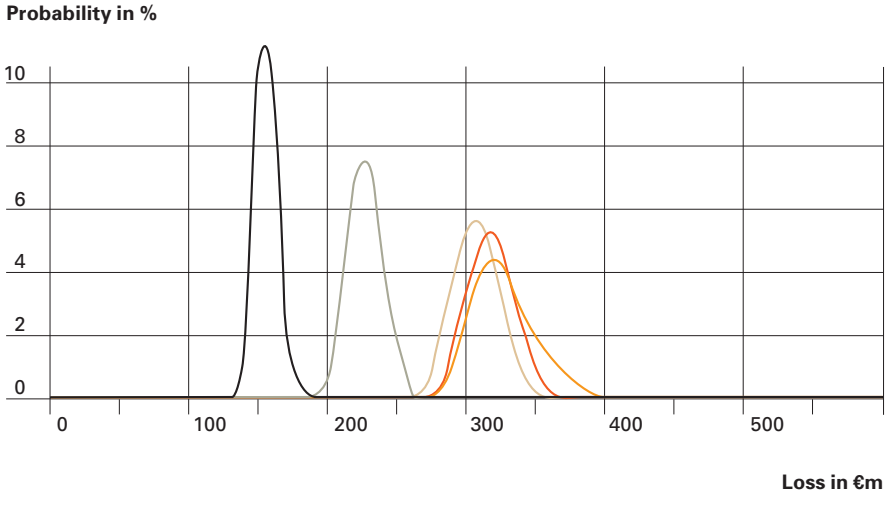
Fig. 10 Overall risk situation of the specimen company without reinsurance



Distribution of aggregate losses

– Expected value	€327m
– 99,5 % quantile	€460m
– Risk capital	€133m
	= €(460 – 327m)

Fig. 11 Comparison of the risk situation with the specimen company's four individual reinsurance programmes



Risk capital

Without RI	€133m	ML50+NP	€36m
PeakRisk	€53m	ALL 50+NP	€24m
NP	€49m		

With reinsurance, the risk capital requirement amounts to between €24m and €53m, depending on the reinsurance programme used. The risk capital requirement for the overall underwriting risk can thus be reduced by up to €109m.

Comparison: Standard model and stochastic partial model

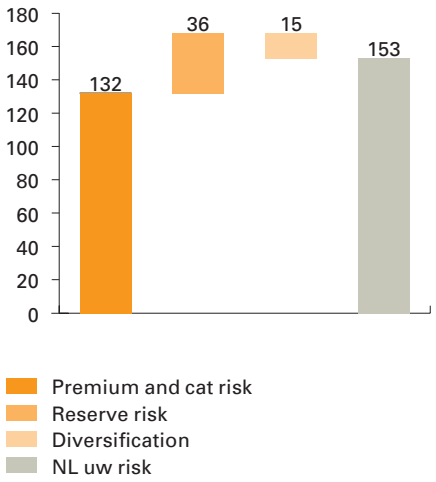
To compare sample results of the standard model with the stochastic model, several assumptions were first made: the balance sheet corresponds to the layout in Table 1 (page 3); the amount of the available capital remains the same, since the values in the balance sheet are principally the market values.

The Solvency non-life underwriting module is made up of the "premium and reserve risk" and the "cat risk". Previously, the stochastic model modelled only the premium risk and the cat risk: to meet QIS4 requirements, the reserve risk has to be modelled as well. This produces a comparable measure for calculating the underwriting risk (Fig. 12).

After this, the remaining types of risk were calculated according to the QIS4 methodology in order to arrive at the overall risk requirement for the specimen company. The SCR calculated with a partial model is lower in every case than that calculated with the standard model; no distortion artefact also results between the PeakRisk and the NP programme (Fig. 14).

The solvency ratio, in turn, is arrived at by comparing the calculated solvency requirements with the available capital. The better modelling of the partial model in itself, even before the use of reinsurance, raises the solvency ratio to 105%, though this is still not a particularly comfortable solvency position. Only the use of the reinsurance programmes increases the solvency ratio substantially, as shown in Fig. 14.

Fig. 12 Modelling the underwriting risk capital (SCRnl) using a stochastic model (€m)



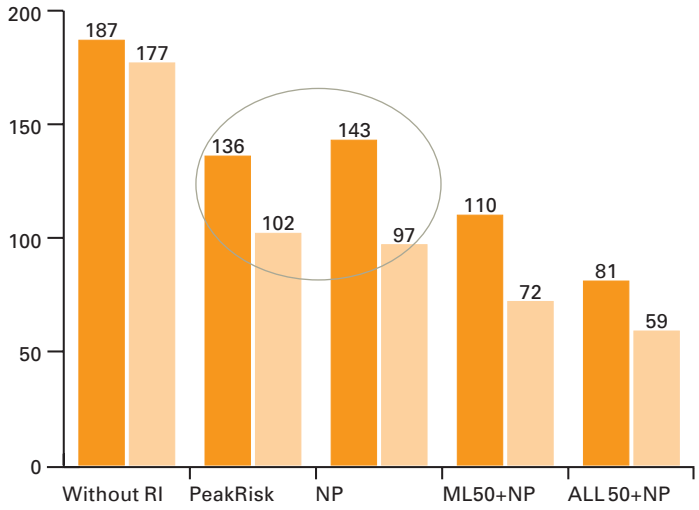
Efficient balance sheet management with reinsurance

Despite its complexity, Solvency II ultimately provides companies with a transparent, holistic view of their risk situation. However, the calculations based on the concrete data of the specimen company also show that a standard model often fails to reflect underwriting properly because of the heterogeneity of insurance portfolios. Yet particularly in property-casualty insurance, underwriting is frequently the main driver of risk and complexity. Here, the introduction of a partial model based on stochastic calculations can help to avoid distortion artefacts and to keep the capital requirement low and the solvency ratio high.

Whichever model the company ultimately chooses, reinsurance reduces the risk capital requirement in both cases. In other words, reinsurance remains the simplest and most flexible way of managing a balance sheet.

Münchener Rückversicherungs-Gesellschaft
Königinstrasse 107
80802 München
Germany
Order number 302-05823

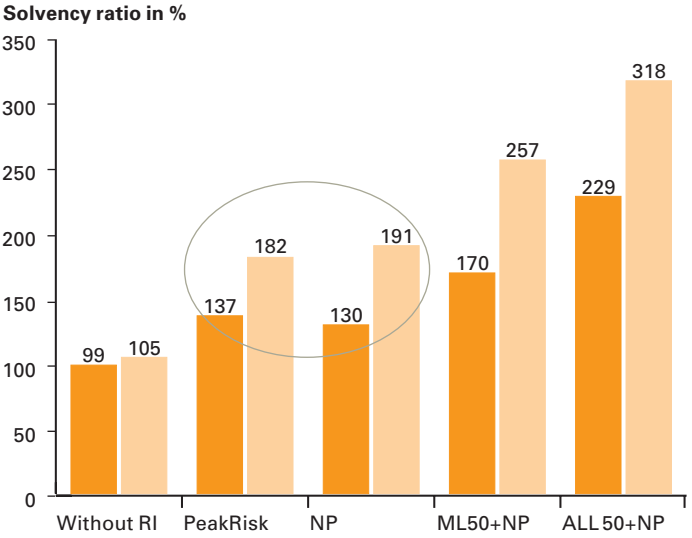
Fig. 13 Comparative impact of reinsurance on the overall requirement for SCR (€m)



Risk capital after the use of reinsurance: Comparison of standard model and stochastic model.

QIS4 standard model
QIS4 partial model

Fig. 14 Impact of reinsurance on the solvency ratio



Substantial: The change in the solvency ratio from using reinsurance programmes.

QIS4 standard model
QIS4 partial model

Solvency Consulting for your company

Munich Re assists its clients in all areas of Solvency II. Using practical examples, Solvency Consulting creates transparency and provides insurers with the knowledge base needed to find a systematic strategy and to plan appropriate measures. Solvency Consulting already has a wealth of experience in the development and use of internal stochastic risk models and their relevance to value-based portfolio management. Furthermore, it is actively involved in important national, European and international supervisory and technical bodies and ensures the transfer of knowledge and the development of recommendations for action in operative business. Our foremost aim in the Solvency II context is to draw up reinsurance programmes for clients geared more individually than ever to their specific needs and wants. We thus offer our clients concrete and efficient help in preparing for Solvency II.