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Non-proportional reinsurance and the Solvency II standard formula

Within the framework of the Solvency II (SII) standard formula, insurance undertakings can realise capital reductions through reinsurance. One of the areas on which, both prior and post introduction of SII, there has been quite some discussion is non-proportional reinsurance within the non-life domain. The current application is a reduction of 20% on the premium parameter for three lines of business (motor liability, fire and general liability). Its main benefit obviously is simplicity, but this also causes downsides.

Firstly, 20% is an average percentage for the entire industry which means that in practice all insurance undertakings have a different effect than 20%. Secondly, it is limited to only three lines of business. These are widespread industries in Europe, but also within e.g. the Marine business line, non-proportional reinsurance is quite common. Thirdly, the factor only applies to the standard deviation for the premium risk component[1] (and thus not to the reserve component). This means that reinsurance through structures like an Adverse Development Cover[2] (ADC) does not qualify for any capital reductions. Fourthly, specific combinations of reinsurance covers, such as an Aggregate XL[3] (on top of a regular non-proportional cover) or specifics of the underlying cover such as an annual aggregate deductible are not captured in this methodology.
A workgroup of the CRO forum therefore investigated whether (some of) these downsides can be (partly) resolved through undertaking specific parameters. The process around the application and maintenance of such parameters is quite demanding though.

Given the downsides of the current approach, various alternatives have been proposed. Three of those alternatives, which all use some (refined) alternative or addition to the adjustment factor are presented below.

1 EXTEND THE CURRENT FRAMEWORK

This alternative would be to continue using the current (simple) methodology but then further apply the adjustment to other lines of business as well. Furthermore, a (to be calibrated) adjustment factor can be added for the reserve standard deviation if an insurance undertaking has an ADC in place.
The main advantage is continued simplicity. The main disadvantage is that it remains a high-level assumption, where the application is insensitive to the actual underlying risk (exposure) and the related cover. Given this draw-back, also applying it the reserve component could lead to an understatement of the overall SCR. Given the crude approach of this methodology, these two points are a genuine concern.

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2. AMICE METHOD

Another alternative has been proposed by the AMICE Mutuals Association. This method, is an improvement which has also been suggested during the QIS5 exercise. The approach is pragmatic, yet more quantitatively based and refined than using the current general adjustment factor. The AMICE method also uses an adjustment factor (or ratio), but it is calculated by the insurance undertaking, taking the reinsurance cover and portfolio specifics into account. The calculation of this factor is fairly straightforward however.

The statistical basis lies in the application of a frequently used model within reinsurance XL modelling, namely the collective risk model (frequency-severity), using Poisson-Lognormal distributions. It is possible to demonstrate that the frequency has no impact on volatility reduction, which means that the λ-parameter does not need to be calibrated. The Lognormal distribution allows for fatter tails in the severity part of the distribution. One could argue that other distributions might be more appropriate in individual cases but given that this is supposed to cover an industry wide application, the use of Lognormally distributed losses to enforce standardisation is not unreasonable. The other advantage is that undertakings do not need to fit these alternative curves themselves (which could lead to subjectivity).

The estimation of the impact of reinsurance on the claim distribution (and volatility reduction) can statistically be derived as follows:

For a given *b* in excess of *a*, the net loss is:

$$Y = \begin{cases} X \text{ if } X \leq a \\ a \text{ if } a < X \leq a + b \\ X - b \text{ if } X \geq a + b \end{cases}$$

and the variance of the random variable *S* aggregate losses after reinsurance is:

$$Var\,(S^{Net}) = \lambda((Var(Y) + E^2(Y))$$

$$\text{From this, it follows that } \frac{Var\,(S^{Net})}{Var\,(S^{Gross})} = \frac{(Var(Y) + E^2(Y)}{Var(X) + E^2(X)},$$

which is independent from the number of claims λ.
Using the above further, then the adjusted (net) premium factor (or ratio) would be:

$$\varphi \cdot \sqrt{\frac{vol^2(Y)+1}{vol^2(X)+1}}, \text{ where: } vol(X) = \frac{\sqrt{Var(X)}}{E(X)},\ vol(Y) = \frac{\sqrt{Var(Y)}}{E(Y)}$$

and φ : volatility factor for premium risk *gross* of reinsurance.

This proposal means that, in order to calculate the effect of reinsurance, only the average claim size and the standard deviation need to be calculated, using the Lognormal distribution. This is a well-known distribution with

$$\text{parameters } \sigma = \sqrt{ln\,(1 + \frac{Var(X)}{E^2(X)})} \text{ and parameter } m = \ln E(X) - \frac{\sigma^2}{2}$$

The following example shows how this could work in practice. Let's assume an average claim amount of 3,000 and a gross premium factor of 15% (e.g. applicable for the Marine segment). The reinsurance layer varies, as does the coefficient of variation (standard deviation/average cost)[4]:

	Unlimited (*b*) in excess of *a*				
Coefficient of variation	*a* = 500,000	*a* = 1,000,000	*a* = 5,000,000	*a* = 10,000,000	*a* = 15,000,000
500%	12.60%	13.76%	15.00%	15.00%	15.00%
1000%	9.28%	10.79%	14.01%	14.88%	15.00%
1500%	7.63%	9.07%	12.80%	14.12%	14.77%

For comparison: the current framework does not allow for any reduction (because the segment is not recognised). Applying the default reduction of 20% would yield a factor of 12%.

The above approach presents an interesting extension to the SF framework which not only makes it more specific for the insurance undertaking and its risk appetite, but also provides the option to extend the same methodology to other lines of business (than the current three). There are also some challenges however, for example:

- Some historical data is needed to perform the calculations. This immediately raises the question how many years (are relevant) and especially whether these years are representative of the risk. The calculations are supposed to lead to an estimate of the 1-in-200 scenario. If historical losses have been low (in terms of amount), the standard deviation might be (severely) understated, leading to an overstated capital requirement;

- If the insurance undertaking has an annual aggregate deductible, the calculations become more complicated to perform and/or standardise;

- The same holds for a limited number of (partly) paid reinstatements. The reinstatement premium needs to be deducted from the XL benefit;

- Calculations are also more complicated in case of the combination of a Per Risk XL and an Aggregate XL.

Despite these challenges, the AMICE method leads to more nuance and potentially broader applications of non-proportional reinsurance within the non-life area.

3. ALTERNATIVE APPROACH TO THE ADJUSTMENT FACTOR

The third alternative to come to the adjustment factor follows an assessment in several steps:

- The portfolio of insurance policies needs to be segregated into groups of insurance policies with similar characteristics;

- These groups should not overlap;

- The reinsurance cover should protect this group of policies against the exact and same risks as the underlying group (with some further detailed requirements);

- The reduction per group of insurance policies is calculated accordingly (see formulas below);

- The reduction for a line of business is calculated by aggregating the relevant groups.

The calculation of the reduction for a group of policies is as follows. First, *A* is calculated as the (gross) capital requirement for a group of policies. The calculation follows the current SII framework:
$A = 3\ \varphi_{nl}\ V_{gross}$, with φ_{nl} being the volatility factor (or standard deviation) and V_{gross} the gross premium for the relevant group of insurance policies. For completeness: the adjustment factor should always be set at 100% at this stage.

The reinsurance cover can only be applied to the extent it remains below the 99.5% percentile. This percentile is obtained by the sum of *BE* and *A*. This means that the relevant part *B* of a certain non-proportional reinsurance cover *b* in excess of a is determined as:
$B = \min(\ a + b,\ A + BE) - a$.

As the reinsurance cover also reduces the best estimate, the reinsurance premium *C* is taken as a proxy for this. As the SF is calibrated on European industry averages, an adjustment factor is required. This adjustment factor γ is set arbitrarily at 50%. The SCR reduction (*Red*) is then calculated as follows: $Red = \gamma\ .\ B - C$.
Using a gross premium of 1,000,000, within the Marine segment (15% volatility factor) and e.g. a 35,000,000 xs 5,000,000 cover for a reinsurance premium of 1,000,000, the adjusted volatility factor would be 9.50% (and the absolute SCR reduction 16,500,000), all assuming that this is the only group of policies within that segment.

As with the two other methods, this alternative framework has drawbacks:

- Similar to the existing framework and the other alternatives presented, the application of an AAD and combinations of reinsurance covers (like an ADC cover on reserve risk) do not fit with this approach, also because of its strict requirements. The same holds for paid, unpaid or partly paid reinstatement(s) of layers;

- The required segregation in groups of reinsurance covers is not always that easy to apply in practice;

- The strict requirements to the groups of policies and the separation of per risk and per event covers might lead to inefficient reinsurance programs to achieve capital benefits;

- The application of the reinsurance premium in the capital requirement leads to catch 22 for insurers; the preference is a low premium for the (IFRS) P&L, but a high premium to achieve direct capital relief.

CONCLUSION

This article presented some alternative approaches to the current 20%-reduction factor for non-proportional reinsurance in three business lines in the SII standard formula framework. The ideal alternative has not been found yet, but the proposals show some interesting directions to remove some of the impediments in the current high-level approach. ■

1 – The SF calculates the SCR by multiplying a standard deviation per line of business time 3 times a volume measure (the monetary amount of premiums). See also articles 115-117 of the SII Delegated Regulation

2 – An ADC protects insurance undertakings from adverse development in their reserves. It could be considered as a stop loss on the reserves.

3 – XL = Excess of Loss (or XoL)

4 – Using a simple R model with 10m simulations