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The Truth About Reinsurance

by Robert P. Stone

The truth about reinsurance is nothing new: reinsurance reduces a company's risk of incurring unacceptably high claims. While this concept is less than mind-boggling, some of the details behind it are worth a quick look.

For a smaller life insurance company without reinsurance, the variability in statutory income caused by a wide range of possible death claim experience is unacceptable. Here's why:

Consider a block of roughly 6000 term policies having face amounts ranging from $10,000 to $1.0M with expected claims in the coming year of $1.335M. The frequency distribution of aggregate death claims for the block (generated via 10,000 Monte Carlo simulations) looks like this:
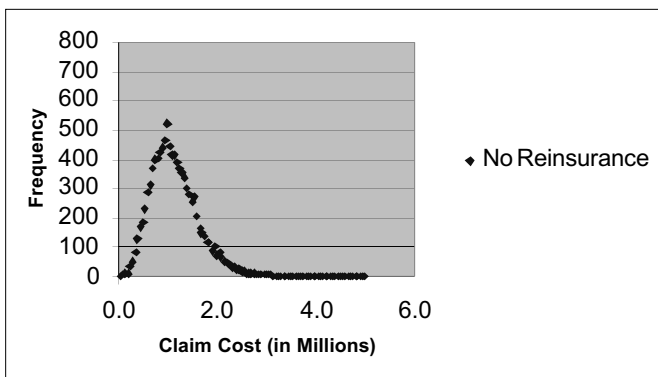
Some selected percentiles of this simulated distribution follow:

Percentile	50th	75th	90th	95th	99th
Aggregate Claims (in thousands of dollars)	1,275	1,630	2,083	2,272	2,883

When considering pro forma financials for the coming year, company management might be very comfortable with a statutory income statement containing death claims equal to the expected amount. This feeling might change if they knew there was a 10% chance claims would exceed $2.03M. And if it could be shown that expected claims would be $2.38M given that they exceeded the $2.03M (i.e. this is the conditional tail expectation), all comfort with the financials might disappear.

Now assume all net amounts at risk above $100,000 are 100% reinsured on a YRT basis. For illustrative purposes, net reinsurance costs are assumed to be 105% of expected reinsurance benefits and expected profit per $1,000 insured is $0.10. Expected unreinsured claims

plus reinsurance costs and forfeited profit are now $1.380M. The simulated frequency distribution of aggregate unreinsured death claims plus reinsurance cost and forfeited profit for the block has been added alongside the prior graph:

Selected percentiles of the new simulated distribution (all values in thousands of dollars):

Percentile	50th	75th	90th	95th	99th
Aggregate Unreinsured Claims	930	1,130	1,325	1,450	1,700
Reinsurance Cost	412	412	412	412	412
Expected Profit Lost	25	25	25	25	25
Total	1,367	1,567	1,762	1,887	2,137

Note the significantly lower values at the 90th percentile and above. The numbers illustrate exactly what the graph shows: the addition of reinsurance has narrowed the range of possible outcomes, i.e. reduced the variance of aggregate claim costs. There is a definite price for this reduced variance, though, as the graph also shows minimum cost of at least the assumed reinsurance cost. Thus the lessened chance of catastrophic death claim experience is traded for part of the potential gain should death claim experience be substantially less than expected.

This exercise can be taken a step further. By running the above example using reinsurance retention other than $100,000, the tradeoff between more or less risk reduction and its cost can be illustrated. Consider the following table of results for various retention limits (all values in thousands of dollars):

Retention	Lowest Sim. Cost	50th Perct.	75th Perct.	90th Perct.	95th Perct.	99th Perct.
50K	915	1,420	1,535	1,645	1,718	1,845
100K	537	1,367	1,567	1,762	1,887	2,137
250K	225	1,320	1,612	1,900	2,079	2,435
500K	131	1,295	1,631	1,981	2,211	2,639
No Reinsurance	100	1,275	1,630	2,028	2,272	2,883

Note the extremes shown in the table on the previous page. By retaining only $50K of face on each policy, the 90th percentile has been reduced by about 20% as compared to the scenario without reinsurance.

These results can be demonstrated another way. The following table shows how pretax profits are affected by the variance in death claims and reinsurance cost (all values in thousands of dollars):

Retention	Expected Claims/Reins Cost On Statutory Income Statement	Impact on Earnings for Claims at Low and High End of Range		
		50% Probability Actual Claims will be in this range	80% Probability Actual Claims will be in this range	90% Probability Actual Claims will be in this range
50K	1,422	119 to (113)	212 to (223)	267 to (296)
100K	1,380	198 to (187)	358 to (382)	443 to (507)
250K	1,347	297 to (265)	508 to (553)	622 to (732)
500K	1,338	347 to (293)	582 to (643)	707 to (873)
No Reinsurance	1,335	375 to (295)	610 to (693)	735 to (937)

As an explanation for the information in this table, consider the 50K retention entries. The expected claims and reinsurance cost of $1.422M could be the death benefit portion of a pro forma statutory income projection. The 50% probability column for this retention limit indicates a $119,000 mortality gain if actual death claims occur at the 25th percentile, while at the 75th percentile, a $113,000 mortality loss would occur. Likewise the 90% probability column illustrates the income statement gain or loss due to actual mortality experience at the 5th and 95th percentiles. It is easy to see that more reinsurance (i.e. lower retention) gives rise to a narrower range of possibilities and more stability in statutory income. With $50,000 retention, there is a 90% chance of actual death claims within $300,000 of the expected value (or in a total range of $563,000). Without reinsurance, this same total range is $1,672,000.

Greater stability in statutory income does have a cost. Note the expected value of the $50,000 retention scenario is $87,000 more than for the unreinsured case. On an expected basis, this amount would be the reinsurance cost using $50,000 retention. Looking at the mortality gain at the 25th percentile (the positive number in the 50% probability column) for these two cases, however, it is evident that in the presence of reinsurance a significant gain is forfeited in a period of better than expected experience.

It should be noted that the assumptions used for reinsurance cost and forfeited profit are somewhat arbitrary. It is conceivable that a competitive reinsurance quote might be for 100% of expected claims or less. While this would affect the relative total costs at each percentile shown above, it would not change the resulting reduction in variance. Also, the impact of reinsurance will vary by company depending on the distribution of policies by face amount. It is therefore not appropriate to make a sweeping statement regarding the desired retention limit for all companies.

Also, all the stochastic analysis in the world is useless if the underlying mortality assumption is flawed (misestimation of the mean). When running stochastic analyses, if a block of business consistently ends up with actual claims in the upper percentiles of the expected distribution, it may be time to review the underlying mortality assumptions.

So the truth about reinsurance remains that same. Reinsurance is about considering the extremes of what can happen and putting a finger on how likely those extremes are. It's about a tradeoff between risk reduction versus the cost of this reduction. And if you are company management, it is about knowing the complete range of risk before and after any reinsurance is in place, so that reinsurance decisions are based on acceptable levels of this risk.

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