

Analysis of proposed reinsurance policy DEF Insurance

Objective

The overall objective is to assess if a proposed reinsurance policy should be written by ABC Re. To do this a model was developed to adjust the historic loss data for claims inflation and use this to estimate the likely frequency and severity of claims. This was used to check if the proposed premium allows ABC Re to make its required margin. And finally the model was updated to calculate the minimum premium required under an alternative scenario and to calculate the Macaulay duration of the cashflows under both proposals.

Data

A history of large commercial property total claims paid (greater than \$1m) on policies written over the last 20 years has been provided by DEF Insurance. Also we have obtained a claims inflation table for commercial property insurance for the last 20 years from the *Actuarial and Statistics Department*.

The claim amounts have all been checked to ensure they are over \$1m. Further data checks should be undertaken to confirm the validity of the claim amounts and inflation rates.

Assumptions

The assumptions used in the model are:

- **The claims data provided by DEF Insurance is complete and accurate.**
- **The claims inflation data provided is suitable for use for DEF Insurance's business.**
- **Claims are assumed to be evenly spread over the year and the claims inflation data is consistent with that, so no calendar adjustment is required.**
- **The policy is for six years and we assume that all outstanding claims are settled in the final quarter.**
- There are no concentrations of risk which are vulnerable to a natural catastrophe event.
- DEF Insurance's exposure to commercial property insurance has been stable over the last 20 years.
- DEF Insurance underwriting policy has been consistent over the last 20 years.
- The premium is paid up front and is free for ABC Re to invest.
- There is no reason to believe events between 2022 and 2028 will differ materially from those experienced over 2001 to 2020.

Methodology

The following steps were taken to complete the analysis.

The first step is to apply claims inflation factors to all the historic claims data to estimate what the claim would cost in 2022 if made then. Using the table of historic claims inflation and adding the assumption that claims inflation would be 3% for 2021 and 2022, a claims inflation factor was calculated for all the years from 2001 to 2020. This was calculated by first calculating an individual factor for each year by adding 100% to each annual inflation rate. Then the claims inflation factor for year X is calculated by multiplying all the individual claims inflation factors for the years X+1 to 2022 inclusive.

The inflation adjusted value of each of the claims is then calculated by multiplying each historic claim by the claims inflation factor for that year to give the inflation adjusted claims values.

Next the payout that ABC Re would make under the proposed policy was calculated for each claim. The proposed policy pays out up to \$5m for any claim in excess of \$5m. So for each claim \$5m is subtracted from each inflation adjusted claim amount. If this is less than zero then there is no payout under the terms of the proposed policy. If the payout is greater than \$5m then the payout is capped at \$5m.

Next we calculated the number of non-zero claims and the average non-zero claim for each of the 20 years.

The next step is to calculate the average frequency of claims per year. This is the simple average of the annual numbers of claims. The average severity of each claim is calculated as the average of all the annual claim averages, weighted by the number of claims in that year.

The expected claims under the policy is the frequency of claims calculated above multiplied by the average severity of claims, also calculated above.

To allow for the investment return that will be earned on the money the present value of the expected claims is calculated. This is calculated by discounting the future claims using an annual discount rate of 3%. The projection of future claims is based in a quarterly payout pattern based on ABC Re's experience. The payout pattern is based on a log normal distribution and all claims are assumed to be paid at the end of the policy term in six years.

The premium under the proposed reinsurance policy is \$15m and the minimum margin that ABC Re required is 10%. So the net premium, which is the amount required to meet the expected total claims, is calculated as the premium of \$15m multiplied by $(100\% - 10\%) = 90\%$.

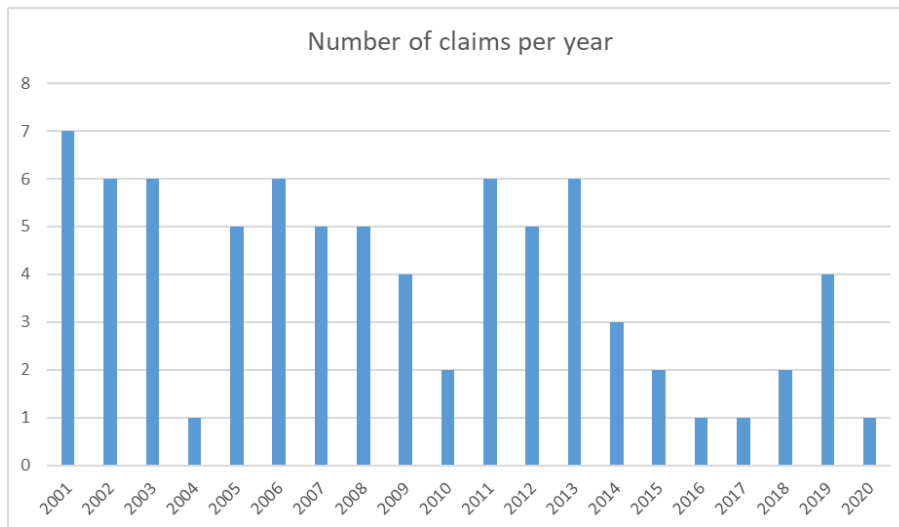
The net premium minus the present value of expected claims gives the expected profit or loss. If this result is a profit (greater or equal to zero) then the policy can be written on the proposed terms. If it is an expected underwriting loss then the policy should not be written by ABC Re.

The Macauley duration of the cashflows was calculated to inform the Investment Manager of the average duration of the reinsurance policy and hence the duration that the assets may be invested at. This was calculated by summing the time weighted future claims amounts and dividing by the sum of the future claims amounts. This was divided by four to convert to an annual duration.

Finally, the analysis was updated with the new policy terms. The new proposed policy paid claims in excess of \$3m up to a maximum payout of \$7m. The calculation of the payout for each historic claim under the new policy terms was updated by changing to the lower excess amount (i.e. \$3m instead of \$5m). The assumed mean of the payout pattern distribution was shortened to seven quarters with the standard deviation remaining same. The purpose is to calculate the minimum premium required so that the new proposed policy would meet the minimum required margin. This was calculated by finding the net premium that would result in a zero profit. Again, the Macaulay duration was found using the same approach as outlined above.

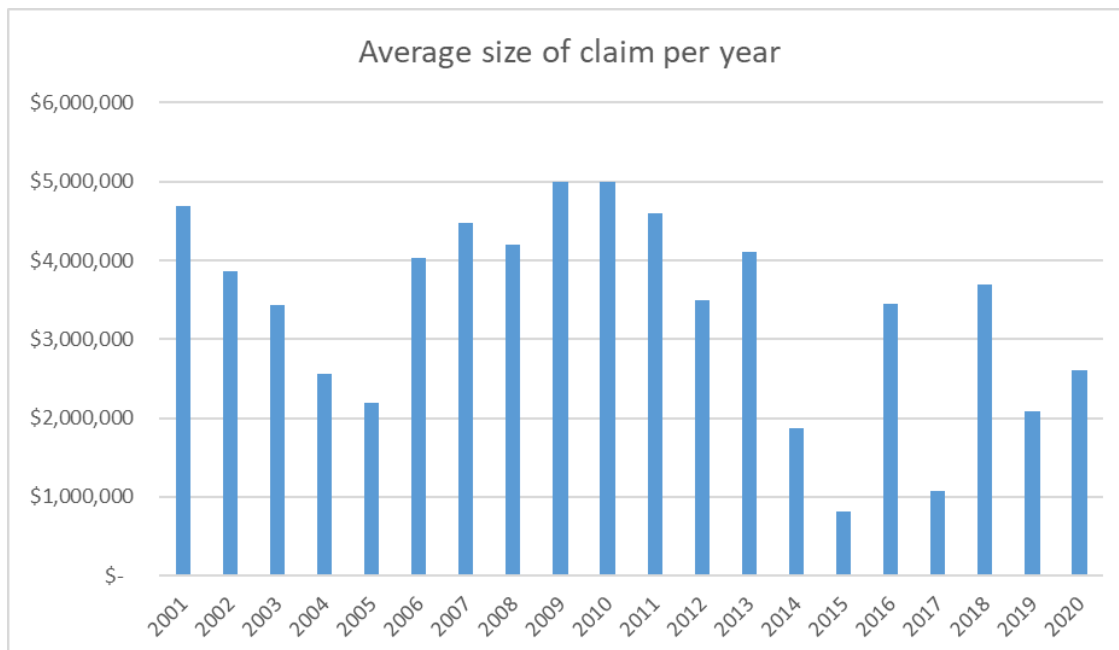
Results

The number of claims payout per year under the original proposal is summarised in the chart below:



The average frequency of claims per annum over the 20 years is 3.9 claims. There has been at least one claim every year for the last 20 years. It can be seen from the chart above that the more recent years (2014 onwards) have had fewer numbers of claims. However, as we are looking at relatively small numbers of large claims it is not clear if this is a trend that will persist or just a short term anomaly.

The average claims size each year is given in the chart below:



As there has been at least one claim every year there is an average size of claim for each year. Also the maximum average claim is \$5m, which is consistent with the terms of the proposed policy. The average severity of claims is \$3.69m, but as can be seen in the chart above there is a lot of variation from one year to the next. This shows that the actual result for the year is very uncertain.

For example, if the maximum loss of \$5m was made for just three claims then this would be sufficient for ABC Re to lose its margin and breakeven overall. Any claims reported in excess of this would cause the policy to be loss making for ABC Re.

Under the terms of the proposed policy the expected profit/loss is in excess of zero at \$65,211 so the proposed policy is expected to be sufficiently profitable for ABC Re and can be written.

The Macauley duration of the projected claims is 2.3 years. The value of the discounting is \$0.94m (i.e. the undiscounted value less the discounted value), which is approximately equal to earning 3% on \$13.5m for 2.3 years (\$0.93m). The inclusion of the investment income is important to support the decision to write the proposed policy as without it the policy would not be sufficiently profitable.

It is reasonable that the investment income on the full premium of \$15m is not taken into account in the underwriting results as ABC Re has ongoing expenses (salaries, overheads etc.) that have to be paid out of the margin made, so the margin is not all available for investment.

New policy terms

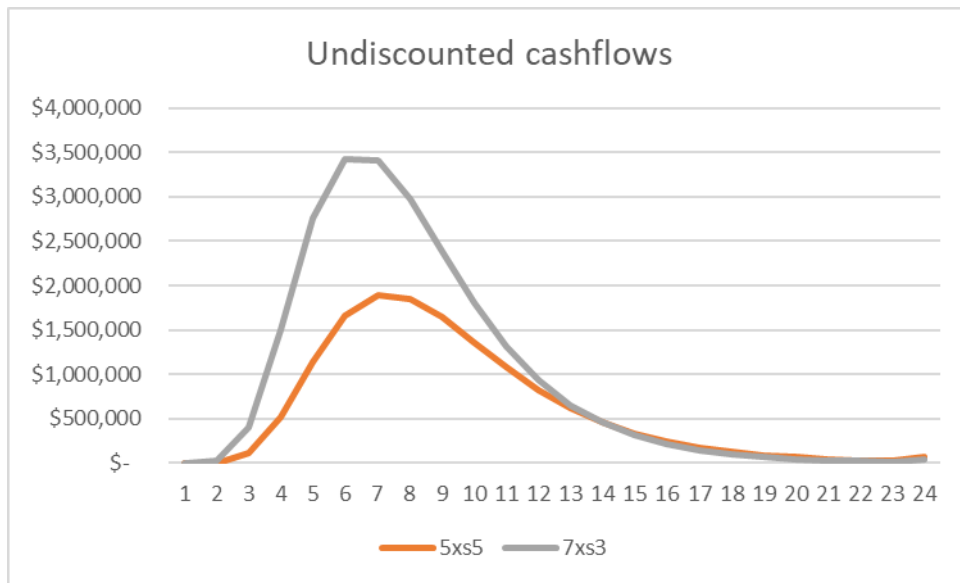
The new policy terms will payout claims in excess of \$3m up to a maximum payout amount of \$7m (known as 7xs3). The frequency and severity estimate change as follows:

	Frequency	Severity
Original policy 5xs5	3.90	\$3.69m
New policy 7xs3	4.85	\$4.75m

It is reasonable that the frequency of claims has increased as any claim over \$3m is now covered by the policy rather than just over \$5m. There is on average approximately one extra claim per year in the \$3m to \$5m range.

It is also reasonable that the average severity of claims has increased, as ABC Re is now exposed to an extra \$2m on all the claims that were in scope under the original proposed policy ($3.90 \times \$5.69m = \$22.17m$). The expected claims under the new policy 7xs3 is \$23.0m (undiscounted) so the expected claims size for one additional claim under the new policy is \$0.86m which is reasonable compared to an average expectation of \$1m. The average expectation is \$1m because the additional loss now covered by the new policy must be between \$3m and \$5m so the payout for ABC Re would average \$1m.

A comparison of the undiscounted projected claims cashflows under both proposed policies is below.



The cashflows under the second proposed policy peak sooner than the original policy, which is consistent with the updated assumption of the mean of the distribution of the payout pattern. Also the volume of claims payments is significantly higher as the second proposed policy covers a wider range of losses.

The duration of the claims cashflows under the original proposal is 2.27 years. This is longer than the mean expectation due to the greater weight assigned to the later cashflows in the calculation of the duration. The duration under the second proposal is 2.01 years (0.26 years less than the original), which is reasonable as the mean assumption was that it was a quarter quicker.

The present value of expected claims for the second proposed policy terms is \$21.7m so a minimum premium of \$24,113,589 would be required for ABC Re to meet its 10% margin requirement.

Conclusions

ABC Re should accept the proposed terms of the reinsurance policy with DEF Insurance on the basis that after making its 10% margin the policy is still expected to be sufficiently profitable. However the result in any one year will be very volatile so ABC Re is exposed to a highly uncertain result.

Next steps

The following are the proposed next steps:

- Check that the claims data from DEF Insurance is up to date
- Check if the more recent claims amounts given are final or are they estimates and subject to change
- Consider a shorter time period over which to calculate the frequency of claims. More recent years seem to have lower numbers of claims.
- Confirm with DEF Insurance that all claims for the more recent years have been reported, so that there are no unreported claims. Or include estimates of any unreported claims.

- Check the claims inflation table against other sources such as industry bodies who might publish independent claims inflation data....
-in particular check the assumed 3% rate for 2021 and 2022 with industry sources
- Produce a table of scenarios with a range of numbers of claims and claim severities to show the profit or loss under each scenario.
- Model the expected future claims stochastically based on a range of outcomes around the frequency/severity assumptions.
- Consider whether ABC Re should include the investment income on some of margin received (\$1.5m) in the calculation of the underwriting profit or loss.
- Consider the investment products available to ABC Re to earn a higher investment income than the current proposal.
- Consider the investment products available to ABC Re to earn a guaranteed investment return to reduce the investment risk....
-however these may lead to liquidity risk if the investment is not available on request and claims are due to be paid
- Sensitivity test the result to the assumption of 3% claims inflation for 2021 and 2022, a small change in the assumption may lead to a different decision as to proceed.
- Sensitivity test the assumptions of the payout patterns.....
.... in particular that claims are paid quicker than currently assumed.
- Consider any regulatory changes, which could affect the claims on commercial property insurance.
- Consider any changes in the legal environment, which could affect the claims on commercial property insurance.
- Confirm that the 10% margin is sufficient for ABC Re to cover its costs
....and in particular the additional capital required to write the policy and hence its costs of capital
- Consider other policy structures that may also be of interest to DEF Insurance, depending on their risk appetite.
- Ask a colleague to peer review the additional work done.