Incorporating a Primary Insurer's Risk Load into the Property Rate

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Abstract: There have been numerous articles giving guidance on how to include the cost of reinsurance in rate indications. What has been missing from the discussion is a method to account for the risk assumed by the primary insurer at the higher layers of the reinsurance program. This note provides such a method, using information from a catastrophe model and a company's reinsurance program.

Keywords: Large loss and extreme event loading, traditional risk load (profit margin)

1. INTRODUCTION

Subsequent to the hurricanes of 2003–2004 came large increases in the cost of catastrophe reinsurance. Insurers responded to these costs in some combination of three ways: by (1) passing the costs along to the consumer, (2) restricting their business in areas prone to hurricanes, or (3) retaining more risk, most likely with the same risk load as the noncatastrophe portion of the homeowner rate. The purpose of this note is to present an elementary method for including a charge for this additional risk in the catastrophe premium and incorporating that charge in the rate indication.

2. BACKGROUND

Assume that an actuary computes the following indication:

[A]	Average Loss and Expense Ratio	70%
[B]	Fixed Underwriting Expenses	5%
[C]	Variable Underwriting Expenses	22%
[D]	(Variable) Profit and Contingency Factor	3%
[E]	Indicated Rate Change	0%

[E]=([A]+[B])/(1-[C]-[D])-1

(Here we assume that all loss adjustment expenses are contained in [A].) Suppose that the company has $10,000,000 in average annual catastrophic loss that the rating agencies and CEO are concerned about. The CEO decides to reinsure 100% of this amount at a cost of $15,000,000. The actuary includes a provision for fixed reinsurance costs as in [6] (see also [3], [2].)

[1]	CY Direct Earned Premium	50,000,000
[2]	Modeled Loss Cost	10,000,000
[3]	Reinsurance Premium	15,000,000
[4]	Reinsured Portion of Loss Cost	10,000,000
[5]=[3]-[4]	Implied Reinsurance Expenses	5,000,000
[6]=[5]/[1]	Provision for Fixed Reinsurance Costs	10%

The actuary then computes the rate indication:

[A]	Average Loss and Expense Ratio	70%
[B1]	Fixed Underwriting Expenses	5%
[B2]	Provision for Fixed Reinsurance Costs	10%
[C]	Variable Underwriting Expenses	22%
[D]	(Variable) Profit and Contingency Factor	3%
[E]	Indicated Rate Change	13.3%

[E]=([A]+[B1]+[B2])/(1-[C]-[D])-1

Practically, the reinsurer will require a retention and a coparticipation of 10%, with a reduction in premium, so assume that the following program is in place.[1]

Layer	Modeled Loss Cost	Reinsurance Premium
$3,000,000 Retention	1,750,000	0
Excess of $3,000,000	8,250,000	11,375,000

The actuary again computes

[1]	CY Direct Earned Premium	50,000,000
[2]	Modeled Loss Cost	10,000,000
[3]	Reinsurance Premium	11,375,000
[4]	Reinsured Portion of Loss Cost	7,425,000
[5]=[3]-[4]	Implied Reinsurance Expenses	3,950,000
[6]=[5]/[1]	Provision for Fixed Reinsurance Costs	7.9%

The actuary then computes the rate indication:

[A]	Average Loss and Expense Ratio	70%

[1] The examples and numbers here are designed to be illustrative.

[B1]	Fixed Underwriting Expenses	5%
[B2]	Provision for Fixed Reinsurance Costs	7.9%
[C]	Variable Underwriting Expenses	22%
[D]	(Variable) Profit and Contingency Factor	3%
[E]	Indicated Rate Change	10.5%

The CEO then makes the following observation to the actuary: "If a reinsurer assumes all the catastrophic risk the cost of assuming that risk is transferred to the policyholders but if the primary insurer assumes some (or all) of that risk, the current methodology doesn't allow us to collect additional premium for the assumption of additional risk."

The actuary knows that the CEO is right. As the underlying risk changes, the profit load should change. The 3% profit and contingencies factor is computed using standard actuarial methods that take into account the short-tailed nature of property lines (see, for example, [5]) but does not properly take into account the catastrophic risk that his company faces. With a base premium of $500 and a catastrophic loss cost of $100, the actuary decomposes the premium.

	Scenario 1 (no reinsurance)	Scenario 2 (100% reinsurance)	Scenario 3 ($3M retention)
Hurricane Loss Cost	100	100	100
Fixed Expenses	25	25	25
Variable Expenses	110	125	122
Profit & Contingencies	15.0	17.0	16.7
Provision for Reinsurance	0	50	41
Other Perils Loss Cost	250	250	250
Indicated Premium	500	567	553

The CEO's complaint is more fully illustrated here. An increase in the company's catastrophic exposure results in a decreased reinsurance premium but doesn't result in a corresponding increase in profit.

3. RESULTS AND DISCUSSION

3.1 Incorporating the Risk Load

The approach taken in addressing this issue is nontheoretic and may not pass the scrutiny of those wishing to view risk transfer within a larger economic framework. The approach is, however, practical and easy to implement. An additional drawback is that it may not pass the review of regulators.[2]

We begin by examining a typical catastrophe reinsurance program. Such a program is divided into layers $L_0, L_1, \ldots, L_n$ and corresponding retained percentages $p_0, p_1, \ldots, p_n$. The expected hurricane loss E[L] is given by $E[L]=\sum_{j=1}^{n}E[L_j]$, the expected retained loss is given by $\sum_{j=1}^{n}p_jE[L_j]$, and the expected ceded portion is $\sum_{j=1}^{n}(1-p_j)E[L_j]$. Each layer has a reinsurance premium R_j. Let λ_j denote the risk premium for layer j, so that

$$1+\lambda_j=\frac{R_j}{(1-p_j)E[L_j]}.$$

We may then formalize the computation the provision for fixed reinsurance costs as follows.

[1] Calendar Year Direct Earned Premium	P
[2] Modeled Loss Cost	$\sum E[L_j]$
[3] Reinsurance Premium	$\sum(1+\lambda_j)(1-p_j)E[L_,]$
[4] Reinsured Portion of Loss Cost	$\sum(1-p_j)E[L_,]$
[5] Implied Reinsurance Expense	$\sum\lambda_j(1-p_j)E[L_,]$
[6] Provision for Fixed Reinsurance Costs	$\frac{1}{P}\sum\lambda_j(1-p_j)E[L_,]$

Note that, as observed earlier, the retained portion of the hurricane losses, $\sum_{j=0}^{n}p_jE[L_j]$, has no corresponding risk load and the additional risk taken on by the primary insurer is not reflected in the indication. To rectify this, we choose π_j with $0\le\pi_j<\lambda_j$. It is at this point where actuarial

[2] Note that Florida specifically addresses this issue in 627.062, F.S. which states that "…For that portion of the rate covering the risk of hurricanes and other catastrophic losses for which the insurer has not purchased reinsurance and has exposed its capital and surplus to such risk, the office must approve a rating factor that provides the insurer a reasonable rate of return that is commensurate with such risk."

judgment or other analysis is used to select the primary company's risk load. Our only constraint is that the reinsurer's risk load is an upper bound for the primary company's risk load. The selection could be guided, for example, by a desire to reach a target risk-adjusted return.[3] The corresponding risk load for layer *j* is then given by

$$\pi_j p_j E[L_j]$$

The total company risk load $\sum \pi_j p_j E[L_j]$ is then built into the indication in the same manner as the provision for fixed reinsurance costs.

Continuing with scenario 3 we see that

$E[L_0]=1,750,000 \quad p_0=1.00 \quad R_0=0$
$E[L_1]=8,250,000 \quad p_1=0.10 \quad R_1=11,375,000$

Clearly $\lambda_0 = 0$ and

$$1+\lambda_1 = \frac{11,375,000}{7,425,000} = 1.532\,.$$

We choose $\pi_0 = 0$ and $0 \le \pi_1 < 0.532$ judgmentally selecting $\pi_1 = 0.25$ gives a risk load for layer 1 of 0.25(825,000)=206,250 and a provision for primary company risk load of 206,250/50,000,000=0.004. Incorporating this into the indication gives us the following adjusted indication.

[A]	Average Loss and Expense Ratio	70%
[B1]	Fixed Underwriting Expenses	5%
[B2]	Provision for Fixed Reinsurance Costs	7.9%
[B3]	Provision for Primary Company Risk	0.4%
[C]	Variable Underwriting Expenses	22%
[D]	(Variable) Profit and Contingency Factor	3%
[E]	Indicated Rate Change	11.1%

[E]=([A]+[B1]+[B2]+[B3])/(1-[C]-[D])-1

[3] A discussion of the computation of a line of business' risk-adjusted return on capital is beyond the scope of this note. The reader is directed to [1] for an introduction.

3.2 Allocation of Loading to Territory

Once we arrive at the appropriate primary insurer risk load we allocate it to territory in the same way that Rollins allocates the Reinsurance Risk Load. For completeness, we illustrate the procedure (see Exhibit 9 of [6].) Let σ_i and e_i denote the standard deviation of modeled losses and exposures for territory *i*, respectively. Let $E[T_i]$ denote the average modeled hurricane loss cost per exposure in territory *i*. The risk load for each territory is given by $k\sigma_i$ where k is chosen so that the total risk load is equal to the sum of the reinsurance risk load. We summarize Rollins' result using the notation from Section 3.1.

The reinsurance risk load (as a percent of gross loss cost) is given by

$$\frac{\sum_{j=0}^{n} \lambda_j (1-p_j) E[L_j]}{\sum_{j=0}^{n} E[L_j]} \tag{3.1}$$

If there are *m* territories then the total risk load is given by

$$\sum_{i=1}^{m} k\sigma_i e_i \tag{3.2}$$

and the total modeled gross loss cost is given by

$$\sum_{i=1}^{m} E[T_i] e_i \tag{3.3}$$

The total risk load (3.2) must equal the product of (3.1) and (3.3) so that

$$k = \frac{\sum_{j=0}^{n} \lambda_j (1-p_j) E[L_j]}{\sum_{j=0}^{n} E[L_j]} \frac{\sum_{i=1}^{m} E[T_i] e_i}{\sum_{i=1}^{m} \sigma_i e_i}$$

It will not, in general, be true that the total expected modeled loss costs in the territorial analysis is equal to the total expected modeled loss costs from the indication. This is because the territorial analysis will generally involve a subset of the risks used in the overall indication.

In order to extend this relationship to include the primary insurer's risk load, we observe that, as a percentage of total modeled hurricane losses, the primary insurer's risk load is given by

$$\frac{\sum_{j=0}^{n} \pi_j p_j E[L_j]}{\sum_{j=0}^{n} E[L_j]}$$

We add this amount to the total reinsurance risk load and get

$$k = \frac{\sum_{j=0}^{n} \left(\lambda_j (1-p_j) + \pi_j p_j\right) E[L_j]}{\sum_{j=0}^{n} E[L_j]} \frac{\sum_{i=1}^{m} E[T_i] e_i}{\sum_{i=1}^{m} \sigma_i e_i}$$

Returning to the illustrative example, suppose that our company has three territories, Inland, Seacoast, and Beach, and that we have the following information.

Territory	Exposures	Modeled Hurricane Loss Cost	Modeled Standard Deviation
Inland	175,000	65	357.5
Seacoast	160,000	225	1,462.5
Beach	100,000	450	3,375.0
Total	435,000	212.36	

We then compute the following.

$\sum_{i=1}^{m} E[T_i] e_i = 92{,}375{,}000$	$\sum \lambda_j (1-p_j) E[L_{,}] = 3{,}950{,}000$
$\sum_{i=1}^{m} \sigma_i e_i = 634{,}062{,}500$	$\sum \pi_j p_j E[L_{,}] = 206{,}250$
$\sum E[L_{,}] = 10{,}000{,}000$	

$$k = \frac{92{,}375{,}000}{10{,}000{,}000} \frac{3{,}950{,}000 + 206{,}250}{634{,}062{,}500}$$

$$= 0.061$$

The allocated risk load is then added to the modeled loss cost to obtain the risk adjusted hurricane loss cost.

Territory	Exposures	Modeled	Modeled	Allocated	Risk-Adjusted

		Hurricane Loss Cost	Standard Deviation	Risk Load	Modeled Loss Cost
Inland	175,000	65	357.5	21.65	86.65
Seacoast	160,000	225	1,462.5	88.56	313.56
Beach	100,000	450	3,375.0	204.36	654.36
Total	435,000	212.36		88.26	300.62

The risk-adjusted modeled loss cost can then be built into the territorial indication using standard actuarial techniques.

3.3 Relationship to Standards of Practice and Statement of Principles

Actuarial Standards of Practice 38 & 39, "Using Models Outside the Actuary's Area of Expertise" and "Treatment of Catastrophe Losses in Property/Casualty Insurance Ratemaking," respectively, provide guidance to the actuary when dealing with catastrophe losses, both actual and modeled. While there are regulatory hurdles and misconceptions concerning the use of the model (see [4] for a discussion of some of these issues), the use of catastrophe models in pricing is by now a standard pricing technique. In fact, projected climatic changes practically mandate the use of a model.

The inclusion of reinsurance costs in the property rate and its allocation to territory are required by the CAS Statement of Principles Regarding Property and Casualty Insurance Ratemaking. The relevant principles are

"A rate provides for all costs associated with the transfer of risk"
"A rate provides for the costs associated with an individual risk transfer."

These costs must include a risk load. Standard of Practice Number 30: "Treatment of Profit and Contingency Provisions and the Cost of Capital in Property/Casualty Insurance Ratemaking," tells us that

"Property/casualty insurance rates should provide for all expected costs, including an appropriate cost of capital associated with the specific risk transfer."

By choosing to retain a portion of the catastrophic risk, a company is putting its surplus at risk. In return for putting that capital at risk, the insurer is entitled to a return commensurate with that risk. Using the reinsurer's risk load as a proxy for an actual market return allows the actuary to incorporate that risk into the rate indication. Performing all of these steps is supported and required by the relevant Standards of Practice and Statements of Principles.

4. CONCLUSION

The primary appeal of this method is its simplicity. We need only do the following:

- Allocate reinsurance premium to state and line of business (this is done, e.g., in [2]).
- Partition the modeled catastrophe loss cost by layer of reinsurance.
- Compute the reinsurer's risk load and select an appropriate company risk load.
- Allocate the company risk load to territory.

The numeric example shown was created to highlight the steps involved. There are no barriers to applying these principles to a more complicated reinsurance program. Finally, while there may be both institutional and regulatory objections to the inclusion of these costs, these objections must be addressed on an individual basis.

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5. REFERENCES

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