Reflecting Catastrophe Risk Load in Property Rates: An Approach

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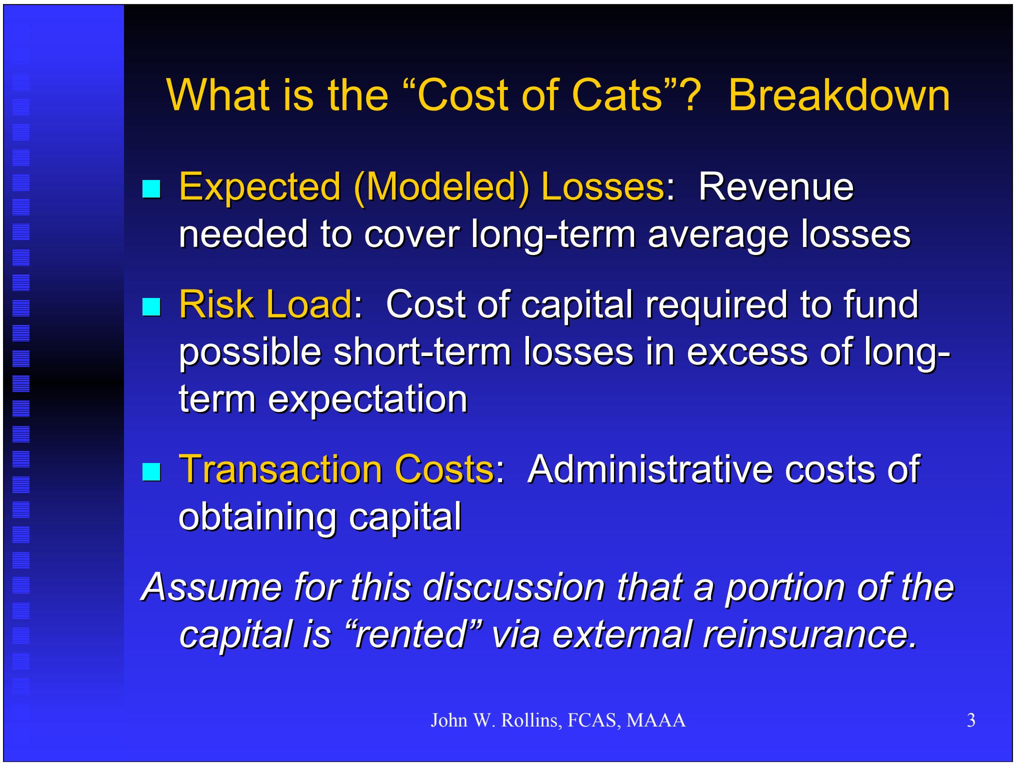
FARM BUREAU INSURANCE

Good morning to my colleagues and friends, and thanks to the CAS Committees on Ratemaking and Special Interest Seminars for the opportunity to talk with you today. I'm Chief Actuary at Florida Farm Bureau, responsible for day-to-day actuarial operations such as rate filings and reserves, solely in the state of Florida. Ratemaking for catastrophic events, including the cost of capital or "risk load", is very important to us. I will ask you to hold major questions until the end, when we will allow plenty of time.

Overview

- Defining the Cost of Catastrophes
- Case Study: Allocations to Line and Territory using Models
- Advantages of “Blended” Ratemaking and Practical Considerations

First, we will review alternative components of the definition of catastrophe losses for ratemaking purposes. Second, we will explore a method for incorporating catastrophe costs, including the cost of capital, into primary property rates at the territory or class level. Defining the cost of cats was covered in my discussion at last year’s Ratemaking Seminar, so it will be a review for those of you who attended last year. Third, I will point out some advantages of the method I am presenting.



There is general actuarial agreement that historical cat losses should be removed in favor of, or blended with, modeled expected cat losses in primary ratemaking. But economic theory suggests strongly that the cost of capital (and any transaction costs associated with obtaining the capital) must also be considered in a market-clearing premium.

This “risk load” reflects the skewed nature of annual cat losses - less than expected value in most years, astronomical in the extreme seasons. The primary company must commit capital, either from its own equity or “rented” from reinsurers or capital markets, to ensure its ability to honor claims in the extreme season. If the capital is rented, its cost is implicit in the reinsurance (ceded) premium. Determining the absolute amount of required capital is beyond the scope here, though I will show how to infer it from empirical ceded premiums. My chief concern is how the cost should be built into the direct rates for individual properties.

If external sources of capital are used, additional transaction costs, such as brokerage commissions or underwriting fees, will be incurred. These are costs of doing business, but is it appropriate to reflect them in rates? We will discuss later.

Ratemaking Options

Premium = Non-Cat Losses + U/W Expenses +

A. Retained E[Cat Losses] + Ceded Premium
B. Modeled E[Cat Losses] + Non-Loss portion of Ceded Premium
C. Modeled E[Cat Losses] + Modeled Risk Load + Reinsurance Transaction Costs

Option A might be described as "net", B as "blended", and C as "direct" ratemaking.

Assume that losses include LAE and underwriting expenses include a primary risk load (profit and contingencies factor) appropriate for non-cat exposure (in many states, prescribed by rule or statute). How do we reflect total cat costs and what do we use to measure each component?

Option A requires the least data. While historical data may be a poor predictor of gross cat losses, it may be an adequate source for retained cat losses. Then the total reinsurance premium is considered as an expense (appropriately divided into fixed and variable) in the rate and covers all non-retained cat costs including the cost of capital.

Option B will be the source for my method. Briefly, a cat model is run on company exposure to generate a modeled loss distribution. This data is used to determine the portion of empirical ceded premium in excess of expected ceded losses (or, cost of capital plus transaction costs). In overall rate level determination, the modeled direct expected losses are added to the non-cat losses and the risk load and transaction costs are added to fixed expenses. In territory ratemaking, the risk load is used along with expected losses to build rate differentials.

Option C is most closely aligned with ratemaking for non-cat lines. The modeled loss distribution is used to calculate expected losses as well as a measure of uncertainty. The charge for uncertainty is directly loaded into the rate based on prevailing risk theory and the metric chosen. At this point, the reinsurance premium is reduced for the loss costs AND risk load, and the leftover portion – transaction costs - may be included in the rates as a variable expense.

Step 1: Ceded Premium by Line

Program	[1] Direct Earned Premium	[2] Property Portion	[3] [1]x[2] Subject Earned Premium	[4] Modeled Expected CAT Loss	[5] [5T]x[4]/[4T] Allocated Ceded Premium
Homeowners	5,000,000	90%	4,500,000	900,000	1,500,000
Mobile Homeowners	2,000,000	90%	1,800,000	500,000	833,333
Dwelling EC	3,000,000	100%	3,000,000	700,000	1,166,667
Businessowners	4,000,000	80%	3,200,000	700,000	1,166,667
Inland Marine	1,000,000	100%	1,000,000	200,000	333,333
Total [T]	15,000,000		13,500,000	3,000,000	5,000,000

All-lines treaty premium of $5M has been allocated on expected CAT losses – assumes volatility of CAT loss is similar by line on statewide basis.

CAT reinsurance programs generally cover all property lines and are priced in bulk, but primary rates are made by line of business. So, the empirical ceded premium must first be allocated to line. Using direct premium would be a disaster, as each line covers structures facing different mean CAT losses. Instead, we use modeled expected losses as the base. If the variability of CAT losses differs significantly by line as well (for example, due to geographic maldistribution of exposures by line), an expected loss allocation may be replaced by a risk-adjusted allocation like the one we will outline in the next few slides.

The subject and direct earned premiums are needed to develop ratemaking provisions in the next steps.

Step 2: Risk Load and Trans. Costs

ITEM	SOURCE	DESCRIPTION	AMOUNT
[1]	Step 1	Direct Earned Premium	5,000,000
[2]	Step 1	Property Subject Premium	4,500,000
[4]	Step 1	Modeled Expected Losses	900,000
[5]	Step 1	Allocated Ceded Premium	1,500,000
[6]	Treaty	CAT Reins. Retention % SMP	10%
[7]	Treaty	CAT Reins. Participation	5%
[8]	([4]-[6]x[2])x(1-[7])	Reinsured Portion of Loss Cost	427,500
[9]	Assumed	Reinsurer Expense Ratio	10%
[10]	[5]x(1-[9])-[4]	Implied Reinsurance Risk Load	450,000
[11]	([5]-[4])/[1]	Provision for Fixed Reins. Costs	12%
[12]	[10]/[4]	Risk Load as % of Gross Losses [K]	50%

The results of Step 1 and actual treaty provisions are combined to find non-loss portions of ceded premium.

The direct and subject property premiums, modeled losses, and allocated ceded premium are carried from Step 1. Retentions and particpations in the treaty are netted out to find the reinsured portion of the expected losses. The ceded premium in excess of these losses covers risk load and transaction costs, and is treated as a fixed expense in ratemaking. An assumed reinsurer expense ratio is used to separate transaction costs from pure risk load. The risk load, along with expected losses, is used to build territory factors later.

Step 3: Overall Rate Level Change

Item	Source	Description	Amount
[1]	data	Direct Non-CAT Loss+LAE	2,100,000
[2]	Step 2	Modeled Expected CAT Losses	900,000
[3]	[1]+[2]	Loss+LAE Including CAT	3,000,000
[4]	Step 2	Present-Level Earned Premium	5,000,000
[5]	[3]/[4]	Experience Ratio	60%
[6]	data	Fixed Underwriting Expenses	10%
[7]	Step 2	Provision for Fixed Reins. Costs	12%
[8]	data	Variable Expenses and Profit	20%
[9]		Overall Rate Level Change	2.5%

[9] = ([5]+[6]+[7])/(1-[8])-1

Expected CAT losses and the reinsurance expense provision are used in the normal rate change formula.

The non-CAT losses and modeled CAT losses are summed and compared to direct premium to form the ratemaking experience ratio (please assume loss development and trends have been accounted for elsewhere). Fixed reinsurance costs are added to other fixed expenses and the traditional rate change formula (loss and fixed expense ratios together, divided by the complement of variable expense ratio) is used to get the indicated overall rate level change.

Step 4: Risk-Adjusted Territory Factors

Ki: 0.068

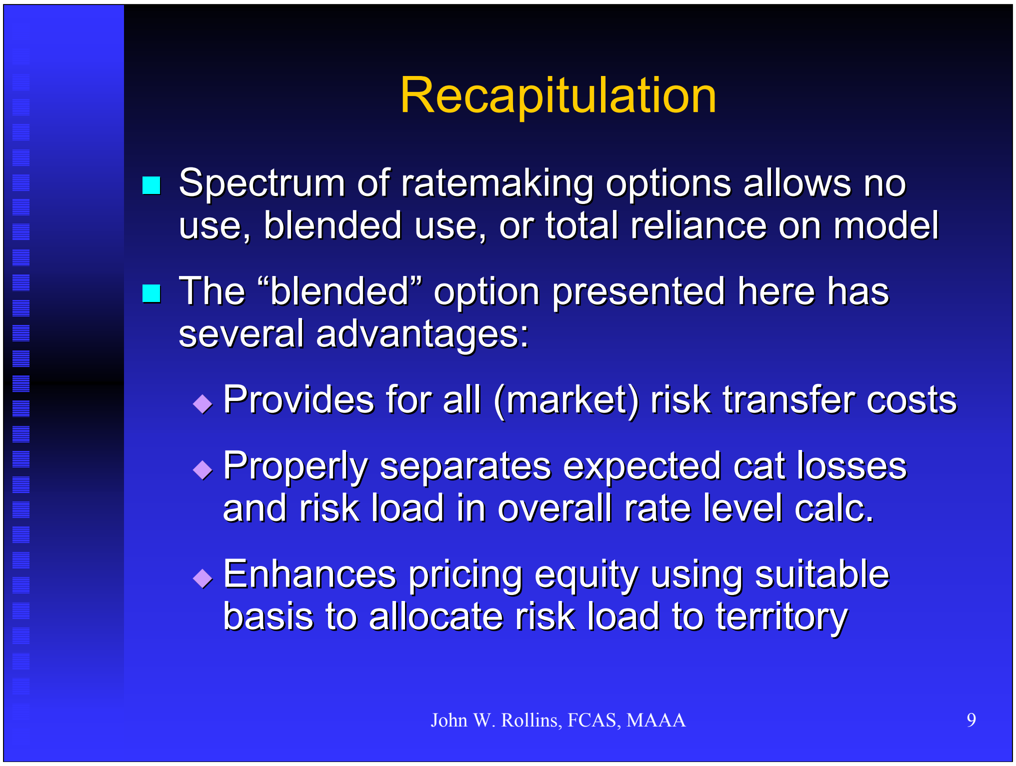
	[1]	[2]	[3]	[4]	[5]	[6]
				[Ki]x[3]	([2]+[4])/[1]	
Territory	Exposure Units	Modeled Expected Losses	Modeled Standard Deviation	Allocated Risk Load	Risk-Adj. Loss Cost	Indicated Relativity
A	100,000	400,000	3,200,000	216,541	6.165	2.283
B	100,000	200,000	1,500,000	101,504	3.015	1.117
C	100,000	150,000	1,050,000	71,053	2.211	0.819
D	100,000	100,000	650,000	43,985	1.440	0.533
E	100,000	50,000	250,000	16,917	0.669	0.248
All	500,000	900,000	6,300,000	450,000	2.700	1.000
			From Step 2:	450,000		

Expected CAT losses AND a measure of their variability are used to build a risk-adjusted relativity.

With location-level cat model output, we can tabulate the simulated cat loss distribution for each modeled location. In particular, the expected value (or other measures of central tendency) and any measure of dispersion can be calculated and aggregated by territory. My example uses the standard deviation as the risk measure, but other quantities can be queried from the results. The variance and the “tail value at risk” (expected value of events in excess of a threshold value) are good candidates. See Meyers and others for extensive actuarial debate over “coherent” measures of risk.

The actual overall risk load calculated in Step 2 is allocated to territory by selecting a scale factor (K_i) in each territory which is applied to the standard deviations to balance the sum of the allocated risk load back to the total amount from Step 2. The scale factor represents a “shadow cost” or implied reinsurance charge. If we assume the charge is the same statewide, we can solve for the K which allocates the actual risk load to territory in proportion to the risk metric (SD).

The risk-adjusted loss cost is the expected losses plus K times the standard deviation per exposure unit, a proxy for the total cost of reinsurance and the basis for developing territory relativities. Of course, loss cost relativities should be converted to premium factors using expense ratios and appropriate algebra.

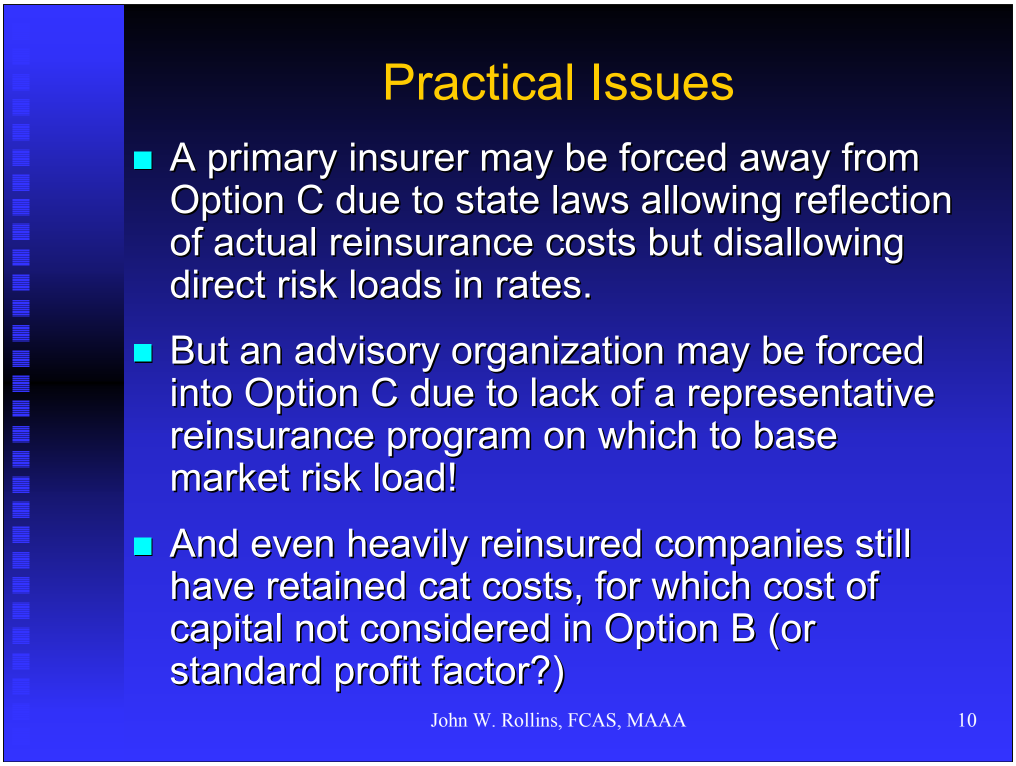


Now that we have seen how to blend model results with empirical risk loads and allocate the cost components in aggregate and class ratemaking, let’s think about the three ratemaking options presented earlier.

Option A excludes ceded cat losses and simply adds the full reinsurance premium back to the rate. While this may include all risk transfer costs as required by the CAS Statement of Principles, the flaw is that without the model, we cannot separate the expected losses from the risk load portion of the ceded premium. I argue that the expected losses should be treated differently from the risk charge in both aggregate and class ratemaking.

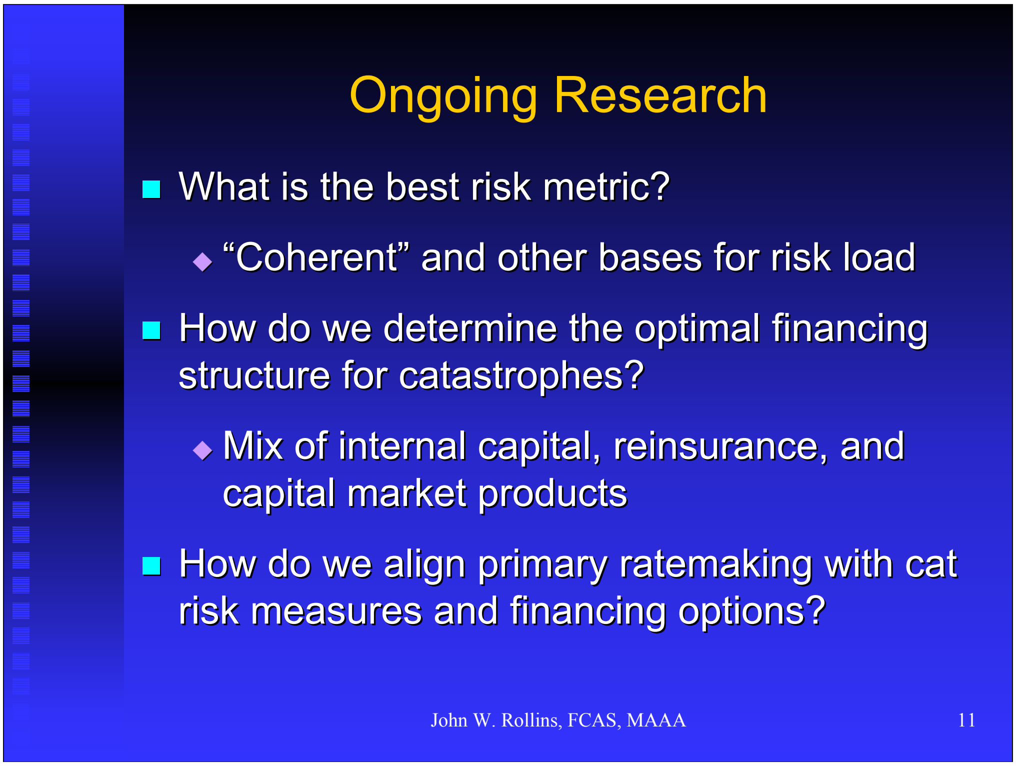
Option C ignores the actual reinsurance costs and builds a risk load directly from the model. The weakness is that the K (shadow cost or scale factor) depends on microeconomic assumptions about utility and risk tolerance. In option B, the (statewide) K is a revealed quantity, but in option C it must be selected and is not tethered to the “real world” of empirical risk transfer costs. This may not bother the theoretician who estimates it from the hurdle rates or internal costs of capital in corporate financial models, but it would certainly bother the CEO if actual capital costs were not fully accounted for in the rates.

Option B provides the best of both worlds for the primary insurer, a risk load based on market reality but one that is separated from expected losses and allocated to line and territory based on an appropriate statistical proxy. Under this option, all costs are reflected in the rates and pricing equity is not sacrificed by class/territory.



Depending on operational factors, the direct option (C) may not be available. Many state laws, including Florida's, explicitly allow reinsurance costs, but disallow calculated risk loads, to be reflected in rates. On the other hand, my colleague Dave Appel will discuss the opposite problem, in which an advisory organization must furnish risk-adjusted loss costs with no reference to reinsurance or other risk transfer programs or prices.

Astute listeners will note that case study really didn't provide for all risk transfer costs. Not considered anywhere in my ratemaking formulas was the appropriate charge for the cost of internal capital used to fund the retained portion of catastrophe losses. Unless you believe this charge is fully reflected in the basic profit and contingency factor (a variable expense) in ratemaking, the modeled expected cat losses which replace the actual cat losses in the overall rate level formula should be loaded for this cost of capital. In practice, I have never seen this done. If reinsurance protection is sufficient, with low retentions and participations, the magnitude of the omission is low. However, with large AADs and high-frequency events (such as hail and tornadoes or smaller tropical storms in some areas), the omission could be significant.



Extensive and fruitful research is ongoing regarding two questions which really precede my concerns in this presentation. First, there is vehement debate within our profession about the proper basis for risk load. Methods based on moments of loss distributions (variance, SD), conditional moments (tail value at risk, expected deficit), and covariance with financial instruments (insurance CAPM, option pricing models) are all in the mix. I am not endorsing an approach, and I point out that any function of the modeled loss distribution could have been used as the basis for my ratemaking option.

Second, many minds are studying the financial economics of insuring cats using the canonical microeconomic concepts of constrained optimization and market equilibrium. Depending upon the available options, there are some surprising results. See the paper I wrote with my colleague Rade Musulin for a Florida-specific example.

Given a risk metric chosen by the actuary and the financing structure chosen by management, primary rates should be set efficiently (they should cover all costs) and equitably (they should charge the average cost of capital as well as expected losses to risks in each territory). This presentation is an attempt to advance one approach.

Thank you for listening. Dr. Appel will now pick up the ball and talk about using direct risk loads in catastrophe ratemaking more extensively. I appreciate your attention and we will take some questions after his presentation.