GUY CARPENTER

Reinsurance Structures and “Optimization”

CAMAR Meeting

October 10, 2012

Discussion Topics

1. Basic Reinsurance Primer
2. Creating a Reinsurance Structure
   - Understanding Goals
   - Rating Agency Concerns
   - Peer comparison
3. Reinsurance Optimization
   - Verify Gross Modeling

Section 1

Basic Reinsurance Primer

Basic Reinsurance Primer
Types of Reinsurance Agreements

Facultative Reinsurance

An Agreement between the ceding company and the reinsurance company which applies to one individual risk of the ceding company, i.e., a restaurant, building, tournament, etc.

Treaty Reinsurance

An Agreement between the ceding company and the reinsurance company which applies to the ceding company's entire book of a specific type of business, i.e., Property, Casualty, Auto Physical Damage, Physician's Malpractice, etc.

Basic Reinsurance Primer
Forms of Reinsurance

Pro Rata Reinsurance (Proportional)

- Sharing concept - Ceding company and Reinsurer share premiums and losses in a determined percentage

Pro Rata

- Quota share
- Surplus share

Excess of Loss Reinsurance (Non-Proportional)

- For a part of the premium, Reinsurers cover losses above a specified retention up to a predetermined limit

Excess of loss

- Per Risk/Per Policy/Per Insured/Per Location
- Per Occurrence (catastrophe)
- Aggregate

Basic Reinsurance Primer
Forms of Reinsurance

Basic Reinsurance Primer
Non-proportional Reinsurance (Excess of Loss)

Different types of Excess relate to the focus of the loss

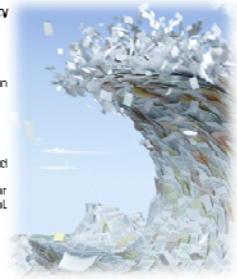
Per Risk Excess	Per Occurrence Excess	Aggregate Excess
• The focus is on the loss to each risk	• The focus is on the occurrence or event or accident • Property Per Occur. (Catastrophe) Excess • Casualty Per Occur. Excess	• The focus is on all losses which occur over a period of time

Basic Reinsurance Primer
Some Terms

- **Rate on Line** – Reinsurance premium divided by reinsurance limit
- **Return Period** – Inverse of the probability that the event will be exceeded in any one year. A 100 year hurricane has a 1/100=1% chance of being exceeded in any one year
- **VaR – Value at Risk** – The loss amount at a given percentile in a loss distribution. For example, the 99th percentile or 100 year loss
- **TVaR – Tail Value at Risk** – The conditional expected amount for events above a certain percentile
- **XTVaR – Excess Tail Value at Risk** – TVaR less the mean

Basic Reinsurance Primer
Some Terms

- **OEP – Occurrence Exceedance Probability**
  - Only considers the largest event in a year
- **AEP – Aggregate Exceedance Probability**
  - Considers that multiple events can happen in one year
  - Used to determine annual aggregate loss (i.e., expected loss)
- **PML – Probable Maximum Loss**
  - In Catastrophe Reinsurance usually stated as a loss at given percentile or return period. For example, the 99th percentile or 100 year loss amount. Usually, equivalent to VaR of the OEP distribution



Section 2

Reinsurance Structure Considerations

Reinsurance Structure Considerations

- What are the company's goals?
  - Preserve/create surplus
  - Ensure (analyst expectations of) earnings
  - Manage volatility
  - Maintain/upgrade rating agency rating level
- Which goals are most important?
- How would the goals be weighted?

Reinsurance Structure Considerations

- A company's risk policy is a key consideration. Need to understand
  - To what return period(s) does the company manages?
  - Risk Tolerance
    - For example, net loss −5.5% of Equity after-tax
  - For catastrophe risk, Cat modeling and exposure monitoring preferences
    - Cat model vendor and version
    - Perspective (Near-term or long-term)
    - Use of storm surge or demand surge
    - Should multiple models be blended?

Reinsurance Structure Considerations

- Alternatives to traditional excess of loss treaties
  - Aggregate cover
  - Top and Drop cover
  - Top and Aggregate cover
  - Structured options
- Consider alternative sources of capacity and collateralized protection
  - Indexed products (ILW, CWIL)
  - Insurance Link Securities (Cat Bonds)
  - Swaps
- Credit risk (for both long tail and short tail lines)
- Experience

Reinsurance Structure Considerations
Rating Agency Concerns – A.M. Best and Cat Reinsurance

- Cat Reinsurance can affect a rating
  - Directly – BCAR calculation uses the Net PML as a deduction to adjusted surplus
    - The higher the Net PML, the lower the BCAR score
  - The stressed BCAR score could show a greater than allowable drop in baseline score
  - Companies risk management practices strongly influence the qualitative review
    - High Net PMLs to Surplus can indicate weaknesses in CAT management
    - Management's ability to articulate use of models and model blends
    - A.M. Best continues emphasizing catastrophe risk management
    - Review of data quality

Reinsurance Structure Considerations
Rating Agency Concerns

Natural Catastrophe Risk In A.M. Best and S&P RBC Models

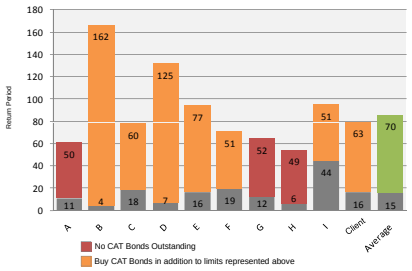
	Capital Adjustment in respect of Natural Catastrophe Risk
A.M. Best	**Greater of 1/100 wind or 1/250 EQ net PML (OEP)***
	+ 2nd event stress test: Greater of 1/100 wind or 1/100 EQ
	Net of:
	– reinsurance and net reinstatement premium
	– tax
	"All boxes ticked" – call for uniform loss assumptions
Standard & Poor's	**Net annual aggregate 1/250 (AEP)**
	Net of:
	– reinsurance and net reinstatement premium
	– 70% of annual underlying premium (property business)
	– tax
	"All boxes ticked" – call for uniform loss assumptions

* Greater of Wind, Earthquake or Terror event for US-domiciled companies

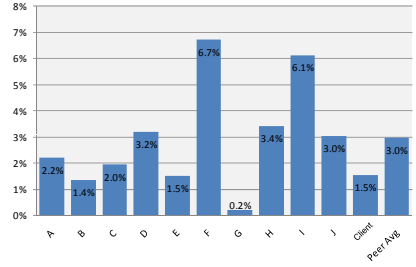
Reinsurance Structure Considerations
Protecting Franchise Value

- Earnings surprises destroy franchise value
  - Merrill Lynch (2007)
    - $3.4b (6.0% of market value) surprise on Oct 24
    - $10.6b (18.6%) market value drop through Nov 7
      - $9.3b (16.3%), adjusting for DJI movement
    - Leverage factor of about 2.74
  - Citigroup (2007)
    - Nov 4 $11b (5.3% of market value) surprise
    - Reduced market cap $51b (24.5%)
    - Leverage factor of 4.63
    - Second surprise gets higher leverage
  - Even if earnings positive and surplus untouched
- What is your (levered) Cat limit as a percent of market value of firm?
- Concerns about standing out in a crisis drive requests for peer review

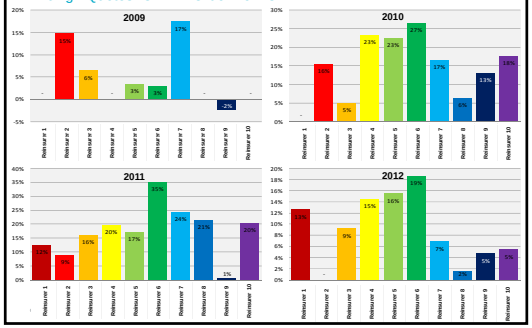
Reinsurance Structure Considerations
Peer Comparison – Return Period Attach/Exhaust



Reinsurance Structure Considerations
Peer Comparison – Retention as a Percent of Capital/Surplus



Reinsurance Structure Considerations
Pricing - Quotes vs. Firm Order Terms



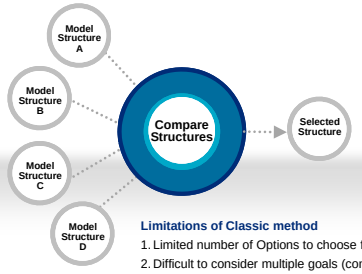
Reinsurance Structure Considerations

- Review retention for optimal combination of
  - Cost
  - Earnings protection
  - Compliance with risk management objectives
- Determine limit for optimal combination of
  - Cost
  - Capital preservation
  - Compliance risk management objectives

Section 3

"Optimizing" A Reinsurance Structure

Classic Reinsurance Structure Evaluation



Limitations of Classic method

1. Limited number of Options to choose from
2. Difficult to consider multiple goals (constraints) at the same time
3. Subjectively limited to initially selected choice of structures

"Optimizing" A Reinsurance Structure
Definition

- op·ti·mize[1]
  verb (used with object)
  1. to make as effective, perfect, or useful as possible.
  2. to make the best of.
  3. Computers – to write or rewrite (the instructions in a program) so as to maximize efficiency and speed in retrieval, storage, or execution.

4. Mathematics – to determine the maximum or minimum values of (**a specified function** that is **subject to certain constraints**).

[1] from dictionary.com

"Optimizing" A Reinsurance Structure
Really Optimal?

- Difficulty in determining a truly optimal solution
  - Combining different treaty types (Per Risk, Excess, Aggregate, Proportional) and non-traditional or alternative capacity
  - Considering different treaty options (e.g., aggregate limits, aggregate deductibles, reinstatements)
  - Understanding market pricing and dynamics for all the above
    - Difficult for less commoditized products and treaty options
    - For some lines, Casualty in particular, the market value for treaty options (e.g., annual aggregate deductible or an extra 50% paid reinstatement) varies significantly by market
- As a result, we "optimize" with constraints around treaty type, coverage and sources of capacity

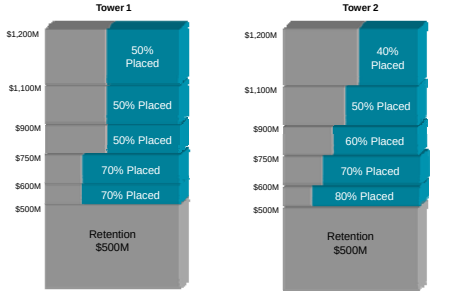
We can demonstrate material improvement in net results

"Optimizing" A Reinsurance Structure
Issues

- Methods
  - All permutations
  - First in analysis – which individual contract provides the best value
  - Last in analysis – which individual contracts provides the least value
  - Sophisticated optimization techniques
- The optimization can converge to a local minimum. To avoid,
  - Start from multiple initial reinsurance programs with different participation percent starting points (e.g., 0%, 50%, 100%)
  - Assume that current program is a good starting point for optimization
- The method to follow is for illustrative purposes, complexities such as
  - more sophisticated cost of capital models (Tranching, Solvency II)
  - recognizing inter-layer correlations

  require more sophisticated techniques

"Optimizing" A Reinsurance Structure
What Participations Are Optimal?



"Optimizing" A Reinsurance Structure
An Illustrative Methodology

Phase 1 – Set goals and constraints of the optimization

Phase 2 – Create gross of reinsurance model and validate results

Phase 3 – Create net of reinsurance model, validate results and verify limit and retentions are adequate

Phase 4 – Evaluate current contracts

Phase 5 – Set initial analysis as current structure and determine capital savings

Phase 6 – Determine efficacy of each contract and adjust as needed

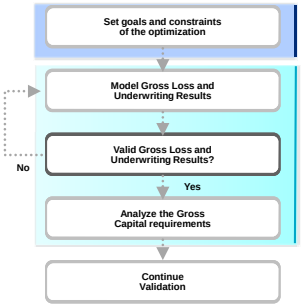
Phase 7 – Determine efficacy of the revised structure and adjust as needed

"Optimizing" A Reinsurance Structure
Phase 1

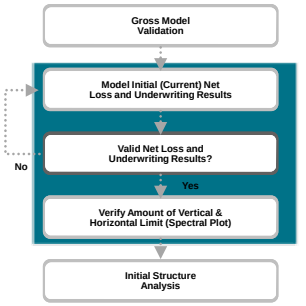
Set goals and constraints of the optimization

- As long as the goals and constraints can be expressed as results coming out of the model there is complete flexibility as to the selected measurements.
- If more than one measurement (metric) is used as a goal, then a rank or weighting of the goals needs to be provided. For example,
  - Maximize ROR (Return on Revenue)
  - Maximize ROC (Return on Capital)
  - Minimize the required capital
  - Minimize the probability of an underwriting loss.
  - Surplus loss at the 20 years return period
- To the extent that more than one measurement (metric) is used as a constraint, each constraint is generally thought of as a stand alone metric.
  - Underwriting Loss at the 100 year return period is less than $X
  - Catastrophe coverage must be purchased up to the Y year return period level.

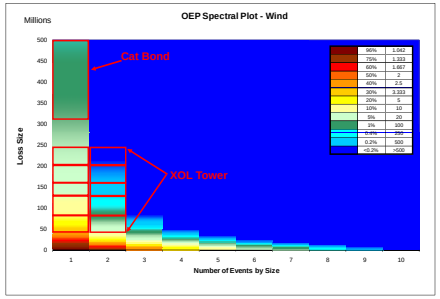
"Optimizing" A Reinsurance Structure
Data / Modeling Validation



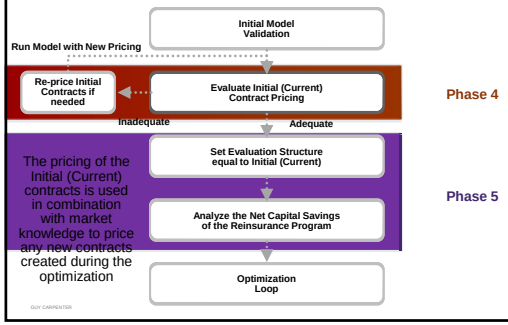
"Optimizing" A Reinsurance Structure
Data / Modeling Validation



"Optimizing" A Reinsurance Structure
Third Phase



"Optimizing" A Reinsurance Structure
Evaluate Initial Pricing

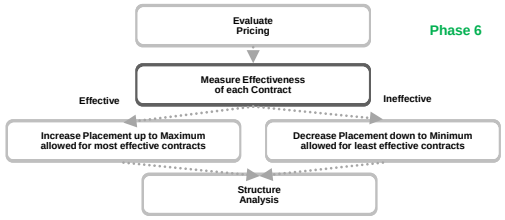


"Optimizing" A Reinsurance Structure
Phase 5

Analyze the Net Capital Savings of the Reinsurance Program

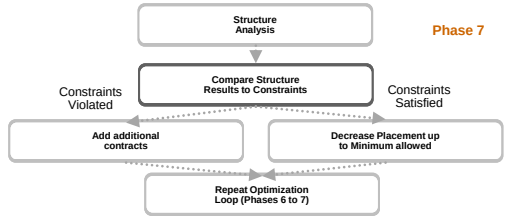
- Use metrics that are consistent with how the company looks at capital
- Calculate the average underwriting profit of the structure and the net capital requirement of the structure.
- The best methods are co-additive:
  - TVaR (Tail Value at Risk) or XTVaR (Excess of Tail Value at Risk)
- The capital required can be measured as a weighted average of various metrics
  - For example, weight all of the following:
    - 50 Year, 100 Year and 250 Year of the XTVaR of loss
    - 50 Year, 100 Year and 250 Year of the TVaR of underwriting loss.

"Optimizing" A Reinsurance Structure
Evaluate Contract Effectiveness



- Effectiveness of each contract is measured by looking at cost of capital for that contract
- Cost is the difference in the mean U/W profit w/ & w/o the contract
- Capital savings is the difference in net required capital w/ & w/o contract
- Contracts with the lowest cost of capital are deemed effective
- Contracts with the highest cost of capital are deemed ineffective

"Optimizing" A Reinsurance Structure
Evaluate Structure Effectiveness



- Compare benefit of New structure to the Current structure based on cost and capital savings.
- If new is better than current, replace the current structure with the new one and go to Phase 6
- If new is not measurably better than the current, return to Phase 6 and make fewer or less aggressive changes to the current structure.
- Continue until reinsurance optimization is achieved

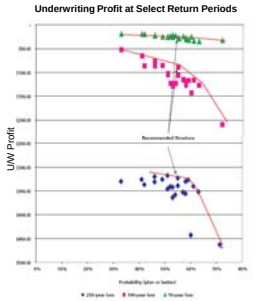
"Optimizing" A Reinsurance Structure
Phase 7

Expanding/Contracting Contracts

- To adjust contracts
  - Proportional - change the placement percentage
  - Excess – 1st change the placement percentage then consider changing contract terms
- Add/remove whole excess contracts at the top/bottom of a tower
- Ultimately all contract terms are available to change
  - pricing/repricing will be required
- Consider the Gross OEP and Spectral Limits plots for guidance on where to set limits and retentions based on company risk appetite
- Consider any inurance issues

"Optimizing" A Reinsurance Structure
Efficient Frontiers

- Some programs are suboptimal
- Other are alternative points on efficient frontier
  - Need to understand company preferences, tolerances, etc.
- 2 dimensions of n-dimensional matrix



"Optimizing" A Reinsurance Structure
Summary of Methodology

Advantages

1. Every Step of the optimization evaluates multiple structure options with each step
2. Process guides you to improvements in the reinsurance structure
3. Allows consideration of multiple goals (constraints) simultaneously

Disadvantages

1. Still requires user judgment
2. Solution is sensitive to the starting point of the optimization
   i. A common problem with optimization projects
   ii. Best protection is to start from multiple starting points
3. Time and Computer Intensive

More sophisticated methods are available that eliminate most of this methods disadvantages. Caveats still remain:

- Need a deep understanding of market pricing of treaty terms and conditions
- Need to understand constraints and risk appetite

"Optimizing" A Reinsurance Structure
Conclusion

We can demonstrate material improvement in net results

Important Disclosure

Guy Carpenter & Company, LLC provides this report for general information only. The information and data contained herein is based on sources we believe reliable, but we do not guarantee its accuracy, and it should be understood to be general insurance/reinsurance information only. Guy Carpenter & Company, LLC makes no representations or warranties, express or implied. The information is not intended to be taken as advice with respect to any individual situation and cannot be relied upon as such. Please consult your insurance/reinsurance advisors with respect to individual coverage issues.

Readers are cautioned not to place undue reliance on any calculation or forward-looking statements. Guy Carpenter & Company, LLC undertakes no obligation to update or revise publicly any data, or current or forward-looking statements, whether as a result of new information, research, future events or otherwise. The rating agencies referenced herein reserve the right to modify company ratings at any time.

Statements concerning tax, accounting or legal matters should be understood to be general observations based solely on our experience as reinsurance brokers and risk consultants and may not be relied upon as tax, accounting or legal advice, which we are not authorized to provide. All such matters should be reviewed with your own qualified advisors in these areas.

30