Capital Allocation: A Benchmark Approach

Risk Lighthouse, LLC

by Dr. Shaun Wang
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Part 1. Review of Capital Allocation Methods

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Portfolio Theory of Capital Allocation

- Most current capital allocation methods are variations of the Markowitz Portfolio Theory, based on portfolio Value-at-Risk and marginal contributions.
  - ✓Diversification benefit is a key driver that impacts allocated capital.
  - ✓It is hard to select correlation parameters among lines of business.

Limitations of the Portfolio Theory of Capital Allocation

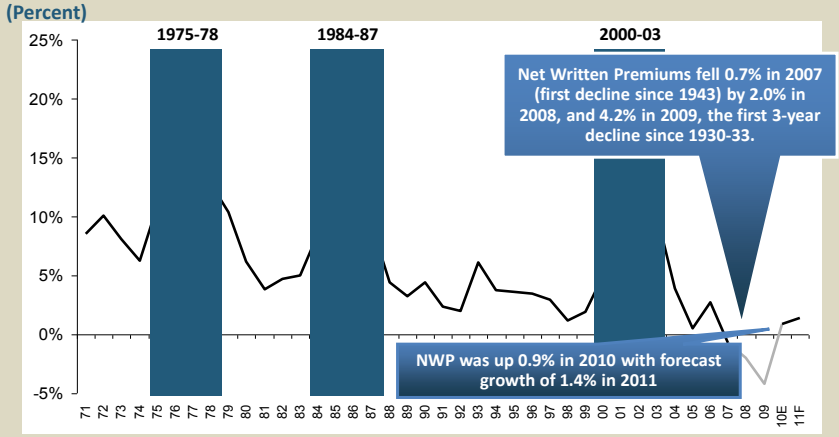
1) Allocation results are highly unstable.
2) Adding a new risk can significantly alter allocated capital for existing risks.
3) Allocation is highly sensitive to the correlation parameters used.
4) Allocated capital to a risk can exceed its policy limit.

Insurance Market Cycles Last for Several Years

- Unlike a stock market which is characterized by random walks, insurance market cycles are played out in slow-motion and last for multiple years.
- Capital allocations need to reflect the through-the-cycle profitability.
- In insurance, customer relation is an important factor in long-term profitability.

Part 1. Review of Capital Allocation Methods

Net Written Premium Growth Rate



Shaded areas denote "hard market" periods
Sources: Insurance Information Institute, A.M. Best, ISO

Part 1. Review of Capital Allocation Methods

A Case Example: Wildly Different Capital Allocation Methods

Gary Venter, Feb 2002 Actuarial Review

In 2001, the CAS Call For Papers to analyze a hypothetical insurer, recommend a reinsurance program, allocate capital, etc.

	Philbrick & Painter *	Bohra & Weist **	
	% of Surplus Allocated	% of Surplus Allocated	Relative Ratio
Workers Comp	41%	11%	3.73
Auto Liab	26%	29%	0.90
HO/CMP Prop	11%	51%	0.22
Auto Phys Dmg	1%	1%	1.00
GL/CMP Liab	21%	8%	2.63
Total	100%	100%	

* From Swiss Re
** From Munich-American Re

Part 2. An Alternative Method: Risk Margins and Benchmark Approach

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The Concept of Risk Margins

- Explicit Risk Margin is now required by some financial reporting proposals.
- It recognizes risk and uncertainty in the amount and timing of future payments needed to satisfy insurance liabilities.
- It reflects market-based price an insurer would rationally pay to be relieved of the insurance liabilities.

Average Risk Margin

- Insurance markets vary widely across products and market segments. We define Average Risk Margin as an aggregated average, or central value, over a portfolio of insurance contracts for a fixed time period.
- At any specific time, the prevailing market risk margin may differ from the Average Risk Margin.

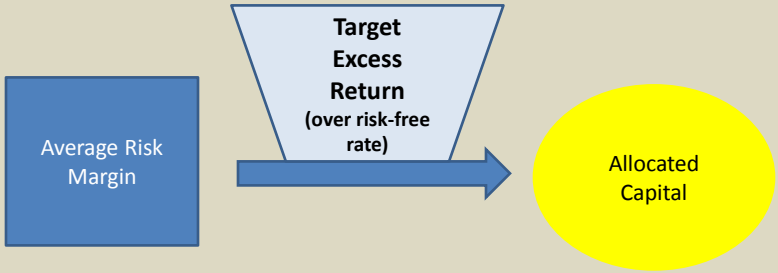
Benchmark Capital Method

- The basic idea: allocated capital is calculated as the ratio of Average Risk Margin and Target Excess Return.

$$\frac{Average\ Risk\ Margin}{Target\ Excess\ Return} = \text{Allocated Capital}$$

- We estimate Average Risk Margin and Target Excess Return using aggregate industry statutory report data.

Benchmark Capital Method



$$\frac{Average\ Risk\ Margin}{Target\ Excess\ Return} = \text{Allocated Capital}$$

Part 3. Risk Margins Using Wang Transform

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Part 3. Risk Margins Using Wang Transform

Theory of Market Price of Risk

- Fund performance (also called Sharpe Ratio):

$$\lambda = \{ \mathrm{E}[R] - r \} / \sigma[R]$$

- Capital Asset Pricing Model:

$$\lambda_i = \mathrm{Corr}(R_M, R_i) \cdot \lambda_M$$

- Black-Scholes-Merton model for options

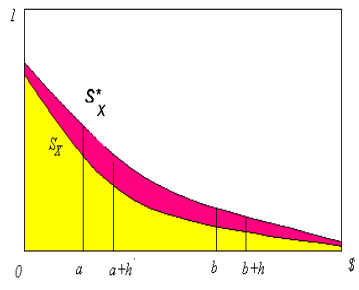
$$\lambda_{Call\ Option} = \lambda_{Underlying\ Asset}$$

Part 3. Risk Margins Using Wang Transform

Financial & Insurance Pricing

Mapping between

1. ***Loss Curve***
   - ***physical measure***
   - ***S(x) = 1- F(x)***
2. ***Pricing Curve***
   - ***risk-neutral measure***
   - ***S*(x) = 1- F*(x)***



Wang Transform

- Maps a loss curve to a price curve:

$$F^*(x) = \Phi[\Phi^{-1}(F(x)) - \lambda]$$

$$\text{E.g. } 0.97 = \Phi[\Phi^{-1}(0.99) - 0.45]$$

  - ✓ Φ is the standard normal distribution
  - ✓ λ extends the **Sharpe Ratio** concept
- Recovers CAPM and Black-Scholes-Merton formula for (log)normally distributed risks

Risk Margin Using Wang Transform

- Let F(x) denote the loss distribution
- Apply Wang transform to derive a risk-adjusted distribution $F^*(x) = t_6[\Phi^{-1}(F(x)) - \lambda]$
- We get risk margin from the transformed distribution

$$Risk\ Margin = E^*(Loss) - E(Loss)$$

Part 3. Risk Margins Using Wang Transform

Estimated "lambda" values from CAT bond transactions:
Effects of 2005 Katrina

Peril Zone	Before 2005 Katrina	After 2005 Katrina
U.S. Wind	0.48	0.77
Europe Wind	0.41	0.53
Japan Earthquake	0.50	0.50

Part 3. Risk Margins Using Wang Transform

Estimated "lambda" values from CAT bond transactions:
Effect of 2001 Japan Earthquake

Peril	Before 2011	After 2011
U.S. Earthquake	0.54	0.55
Japan Earthquake	0.50	0.64

Part 4. Proposed Benchmark Capital Allocation

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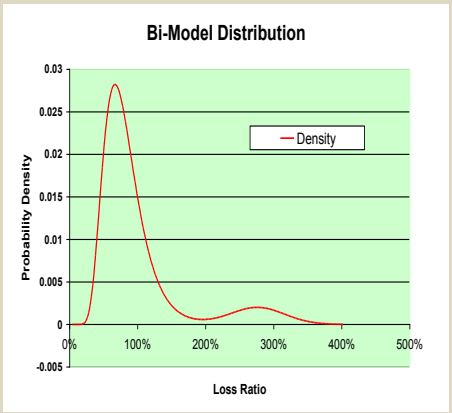
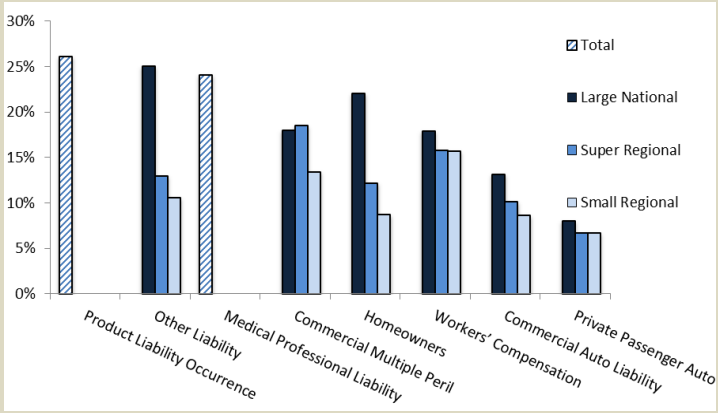
Example of Coefficient of Variation of Net Loss Ratios (AY 1987-2004)

- Apply Wang transform to stylized risk ratio distribution for a line of business
- Use benchmark price to back out required capital charge



Part 4. Proposed Benchmark Capital Allocation

Applications in Calculating Capital Charges



Part 4. Proposed Benchmark Capital Allocation

Use Wang transform to derive Capital Charge Factors for ground-up risks

		Sharpe Ratio		Target Excess Return Over Risk-free Rate
		0.3		10%
	UW Year	Payout	Annualized	Annual Capital
Line of Business	Volatility	Duration	Volatility	Charge Factor
PPA Liab	4.0%	2.3	2.6%	0.08
Prem/Ops Small	11.3%	3	6.5%	0.20
Prem/Ops Large	26.4%	6	10.8%	0.32
Comml Auto NonFleet	6.9%	3.8	3.5%	0.11
Comml Auto Fleet	37.1%	3.8	19.0%	0.57
Worker Comp Small	12.6%	10	4.0%	0.12
Worker Comp Large	28%	11.3	8.2%	0.25

Part 4. Proposed Benchmark Capital Allocation

Apply Wang transform to derive relativity (excess vs. ground-up) in capital charge factors

	150 xs 100	250xs250	500xs500	1M xs 1M	3M xs 2M	5M xs 5M
Pers Auto Liab		1.67				
Comm Auto Liab NonFleet			1.67			
Comm Auto Liab Fleet	1.2	1.45	1.67	2	2.8	3.5
Prems/Op Small	1.2	1.45	1.67	2	2.8	3.5

Part 4. Proposed Benchmark Capital Allocation

Adjust for Payment Duration "D"

- Let D denote the duration of payment pattern for a line of business.
- The market price of risk for an Accident Year λ_{AY} can be adjusted for duration to derive an 1-year parameter: $\lambda_1 = \frac{\lambda_{AY}}{\sqrt{D}}$.
- This gives a middle ground of the two extremes: MunichRe vs. SwissRe methods.

Thank you!

Contact

Dr. Shaun Wang, FCAS, MAAA
One Atlanta Plaza, Suite 2160
950 E. Paces Ferry Road NE
Atlanta, GA 30326-1384
Phone: 678-732-9112
shaun.wang@risklighthouse.com
www.risklighthouse.com