GE Insurance Solutions protects people, property and reputations. With over $50bn in combined assets, the GE Insurance Solutions group of companies is one of the world’s leading providers of commercial insurance, reinsurance and risk management services.

Life, Health, Property and Casualty

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Overview and Asking Prices
Overview

- Context: Asking Price model reflecting frictional capital costs
- Insurance capital is a Shared Asset
- Two distinct types of usage: consumptive and non-consumptive
- More appropriate financial analogue than IRR: Letter-of-Grant (~letter of credit)
- Advocates EVA as decision metric

Reinsurance Market Structure

Broker Market, Large Treaty Placements

(I) Seeking Quotes

<table>
<thead>
<tr>
<th>RE #1</th>
<th>RE #2</th>
<th>RE #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss Cost estimate</td>
<td>Expenses</td>
<td>Target Profit Margins</td>
</tr>
<tr>
<td>Strategy Differential</td>
<td>Profit Margin</td>
<td>ASKING Price</td>
</tr>
</tbody>
</table>

(II) Market Price Formation

BROKER

RE #1
RE #2
RE #3

Must factor in Cedent's EDA Price
Consider the range of asking prices
Soft factors

(III) Filling Slip

May re-enterer on the Approved List
Review the Price
Question becomes a Question of Volume
Need Price Evaluation

LEADING MARKETS
ONLY

ANYONE WITH A PULSE

Variations in Asking Prices

- If Ask X is much higher than others:
  - May steer final price upward
  - May indicate lack of interest
  - May result in lower share being proposed
- If Ask X is much lower than others:
  - May steer final price downward
  - May indicate strong interest
  - May result in higher share being proposed

Conclusions:
- Signaling power in Quote
- Limited arbitrage opportunity

Quotes Will Vary Due To:
- Proprietary Loss Cost models
- Internal expense loads
- Strategy Differential (aggressive or averse signaling)
- Profit Margin - e.g.
  - Based on marginal impact to own portfolio
  - Based on own funky cost of capital model
  - Based on ownership's economic rent and margins
Reasons Why Asking Prices Should Vary

1) Liquidity requires diversity of opinion and losers
2) Anti-trust
3) Parameter uncertainty
4) Information asymmetry
5) …

Shared Asset – Theory

Parental Guarantees

- Merton-Perold: “risk capital” for a business unit should be cost of parental guarantee to make up any operating shortfall
- Valuing this guarantee is easy when there are capital market equivalents
- What about low liquidity, informationally opaque guarantees?
  - E.g., Insurer portfolio of liabilities
  - Insurer provides shortfall guarantee to each policy it underwrites
  - Guarantee is issued by the entity in total, similar to a Letter of Credit (LOC)
  - Exercise of guarantee by product segment depends on:
    - Volatility
    - Price adequacy
    - Reserve adequacy
  - Company must manage the timing and size of guarantee exercises (i.e., an internal bank run)
Insurer Capacity – Definition

- Legitimate standing as a counterparty is essential to their market viability claims-paying rating.
- Key rating variable is capital adequacy ratio (CAR) = Actual Capital / Required Capital.
- Each rating has a minimum CAR associated with it.
- If Actual Capital is fixed, then there is a maximum Required Capital constraint.

Required Capital = fn(Premium, Reserves, Assets).
For planning purposes, assume reserves and assets are fixed.
Required Capital constraint really means a Premium Constraint.
Required Premium Capital = excellent proxy for underwriting capacity.

Insurer Capacity – Occupation

- Underwriting activity generates required capital either Current Year Premium or Reserves.
- Since insurer is subject to a maximum Required Capital, underwriting activity occupies available capacity.
- Longer duration business occupies capacity for a longer time.
- Any occupation of capacity precludes the insurer from using that capacity to underwrite other products.
- Clear opportunity cost.

Required Premium Capital As Capacity Constraint

<table>
<thead>
<tr>
<th>PLAN</th>
<th>IMPACT OF RESERVE STRENGTHENING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required Premium Capital</td>
</tr>
<tr>
<td></td>
<td>Balance</td>
</tr>
<tr>
<td>Premium</td>
<td>600</td>
</tr>
<tr>
<td>Reserves</td>
<td>1,000</td>
</tr>
<tr>
<td>Assets</td>
<td>3,000</td>
</tr>
<tr>
<td>Actual Capital</td>
<td>2,000</td>
</tr>
<tr>
<td>Actual CAR</td>
<td>200%</td>
</tr>
<tr>
<td>Min CAR</td>
<td>200%</td>
</tr>
</tbody>
</table>
Insurer Capital Is A Shared Asset

Asset Owners:
- Control Overall Access Rights
- Preserve Against Depletion From Over-Use

Shared Asset
Reservoir, Golf Course, Pasture, Hotel, Insurer Capital

User 1
- Consumes On Standalone Basis
- Tunnel Vision - No Awareness Of The Whole

User 2
User 3
User 4
- Consumes On Standalone Basis
- Tunnel Vision - No Awareness Of The Whole

Asset Owners Control Overall Access Rights and Preserve Against Depletion From Over-Use.

Shared Assets Can Be Used Two Different Ways

- **Consumptive Use**
  - Example: RESERVOIR
  - Permanent Transfer To The User

- **Non-Consumptive Use**
  - Example: GOLF COURSE
  - Temporary Grant Of Partial Control To User For A Period Of Time

- **Both Consumptive and Non-Consumptive Use**
  - Example: HOTEL
    - Temporary Grant Of Room For A Period Of Time
    - Guest could destroy room or entire wing of hotel, which is Permanent Capacity Consumption

An Insurer Uses Its Capital Both Ways

- 1. **“Rental” Or Non-Consumptive**
  - Returns Meet Or Exceed Expectation
  - Capacity Is Occupied, Then Returned Undamaged
  - A.k.a. Room Occupancy

- 2. **Consumptive**
  - Results Deteriorate
  - Reserve Strengthening Is Required
  - A.k.a. Destroy Your Room, Your Floor, Or Even The Entire Hotel

Charge portfolio segments for both uses of Capital.
Two Kinds Of Charges:

1. **Rental** = Access fee for LOC
   - Function of **Capacity Usage** (i.e., Rating Agency Required Capital)
   - Opportunity Cost of **Occupying Capacity**

2. **Consumption** = Drawdown fee for LOC
   - Function of **Downside Potential** (i.e., segment economic shortfalls)
   - Opportunity Cost of **Destroying Future Capacity**

Charge portfolio segments for **Both Uses** of Capital

---

**IRM Portfolio Mix Model**

**Economic Value Added or EVA**

- **EVA** = Return – Cost of Capital Usage
- Factors in:
  - Capacity Usage (finite supply, driven by external S&P requirements)
  - Company Risk Appetite
  - Product Volatility
  - Correlation of Product with Portfolio

**Powerful Decision Metric For Your Consideration**

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**Capital Usage Charges: Calculation**

1. **Downside** = Max(Simulated Loss > Expected Loss, 0)
2. Capital rental charge (access fee)
   - *(Ex: 10% of required capital balance)*
3. Charge for drawdown on required capital
   - *(Ex: 50% of underwriting result)*
4. Charge for drawdown beyond required capital
   - *(Ex: 100% of u/w result beyond capital allocation)*
Capital Usage Charge Calculation Example

- Charges:
  - (A) Rental = 10%
  - (B) Within Capital = 50%
  - (C) Beyond Capital = 100%
- Required Capital = $5M

  - Loss = Exp Loss
  - Capital Usage Cost
  - Trial 1: - $2M
  - $2,000K
  - Trial 2: - $3M
  - $500K + $3M * 50% =...
  - Trial 3: - $8M
  - $500K + $5M * 50% + $3M * 100% = $6,000K

- Steepness of penalty depends on relative difference between (B) Within Capital and (C) Beyond Capital charges.

Why is Downside Based on Loss Only?

- Sticking to the facts:
  - Earn premium, set up reserve = EP*Plan LR.
  - Remainder after expenses (if any) goes to underwriting profit that year.
  - For a LOB with any tail, reserve deterioration beyond Plan LR occurs in future years, and therefore must be funded from future capital.
  - LOB profit shows up not in reducing the capital usage cost but in increasing the EVA, or in comparisons of actual TM versus required TM.
  - Another advantage: avoids recursion in determining required TM.

Gradations of Consumption Fee?

- Financial distress costs
  - Impairment
  - Downgrade
  - Loss of market viability
  - Loss of franchise value (present value of growth options or PVGO)
  - These increase with magnitude of capital depletion
  - Kreps makes a similar argument in his “Riskiness Leverage Models” paper
### Simple Pricing Examples

#### Example 1
**Property Catastrophe Contract**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Premium</td>
<td>$500,000</td>
</tr>
<tr>
<td>(2)</td>
<td>Limit</td>
<td>$10,000,000</td>
</tr>
<tr>
<td>(3)</td>
<td>Required Capital</td>
<td>$50,000</td>
</tr>
<tr>
<td>(4)</td>
<td>Required Capital</td>
<td>$250,000</td>
</tr>
<tr>
<td>(5)</td>
<td>Opportunity Cost for Capacity</td>
<td>10.0%</td>
</tr>
<tr>
<td>(6)</td>
<td>Capacity Occupation Cost</td>
<td>$25,000</td>
</tr>
<tr>
<td>(7)</td>
<td>Probability</td>
<td>2.0%</td>
</tr>
<tr>
<td>(8)</td>
<td>Loss</td>
<td>$10,000,000</td>
</tr>
<tr>
<td>(9)</td>
<td>Capital Call Amount</td>
<td>$9,500,000</td>
</tr>
<tr>
<td>(10)</td>
<td>Capital Call Cost Function</td>
<td>50.0%</td>
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<tr>
<td>(11)</td>
<td>Capital Call Charge</td>
<td>$4,750,000</td>
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<tr>
<td>(12)</td>
<td>Expected Capital Call Cost</td>
<td>$95,000</td>
</tr>
<tr>
<td>(13)</td>
<td>Expected NPV</td>
<td>$300,000</td>
</tr>
<tr>
<td>(14)</td>
<td>Expected Capital Usage Cost</td>
<td>$130,000</td>
</tr>
<tr>
<td>(15)</td>
<td>EVA</td>
<td>$180,000</td>
</tr>
</tbody>
</table>

**Argument that Opp Cost should get larger over time – comparable to the liquidity premium argument for a positively sloping yield curve**

---

#### Example 2
**Longer Tail Excess of Loss Contract**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Premium</td>
<td>$500,000</td>
</tr>
<tr>
<td>(2)</td>
<td>Limit</td>
<td>$10,000,000</td>
</tr>
<tr>
<td>(3a)</td>
<td>Required Capital Factor - Premium</td>
<td>80.0%</td>
</tr>
<tr>
<td>(3b)</td>
<td>Required Capital Factor - Reserves</td>
<td>35.0%</td>
</tr>
<tr>
<td>(3c)</td>
<td>Reserve Amount</td>
<td>$185,000</td>
</tr>
<tr>
<td>(4)</td>
<td>Required Capital</td>
<td>$334,004</td>
</tr>
<tr>
<td>(5)</td>
<td>Opportunity Cost for Capacity</td>
<td>10.0%</td>
</tr>
<tr>
<td>(6)</td>
<td>Capacity Occupation Cost</td>
<td>$32,463</td>
</tr>
<tr>
<td>(7)</td>
<td>Probability</td>
<td>2.0%</td>
</tr>
<tr>
<td>(8)</td>
<td>Loss</td>
<td>$7,085,262</td>
</tr>
<tr>
<td>(9)</td>
<td>Loss NPV</td>
<td>$7,385,262</td>
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<tr>
<td>(10)</td>
<td>Capital Call Amount</td>
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<td>(11)</td>
<td>Capital Call Charge</td>
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<tr>
<td>(12)</td>
<td>Expected Capital Call Cost</td>
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<tr>
<td>(13)</td>
<td>Expected NPV</td>
<td>$185,719</td>
</tr>
<tr>
<td>(14)</td>
<td>Expected Capital Usage Cost</td>
<td>$185,719</td>
</tr>
</tbody>
</table>

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Pricing Implications

- No more ROE at Product level
- EVA becomes the decision metric
- Impact of product on company risk position is reflected in Cost of Capital Usage
- Another Cost = reflected by deducting from revenue
- Capital Usage Cost factors need to be calibrated
- Capital Usage Cost factors, and method, will steer portfolio composition

Demo Portfolio Model

<table>
<thead>
<tr>
<th>Loss Generator</th>
<th>LOB 1</th>
<th>LOB 2</th>
<th>LOB 3</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log N Sigma (CV)</td>
<td>30.0%</td>
<td>50.0%</td>
<td>70.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Expected Loss</td>
<td>1,000,000</td>
<td>1,000,000</td>
<td>1,000,000</td>
<td>3,000,000</td>
</tr>
<tr>
<td>Profit Margin</td>
<td>5.0%</td>
<td>5.0%</td>
<td>5.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Variable Expense Ratio</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Plan Premium</td>
<td>1,052,632</td>
<td>1,052,632</td>
<td>1,052,632</td>
<td>3,157,895</td>
</tr>
<tr>
<td>Expected Loss Rate</td>
<td>95.0%</td>
<td>95.0%</td>
<td>95.0%</td>
<td>95.0%</td>
</tr>
<tr>
<td>Return $</td>
<td>52,632</td>
<td>52,632</td>
<td>52,632</td>
<td>157,895</td>
</tr>
<tr>
<td>Plan Loss Rate</td>
<td>95.0%</td>
<td>95.0%</td>
<td>95.0%</td>
<td>95.0%</td>
</tr>
<tr>
<td>Plan Loss $</td>
<td>1,000,000</td>
<td>1,000,000</td>
<td>1,000,000</td>
<td>3,000,000</td>
</tr>
</tbody>
</table>

- Simplistic simulation model to demonstrate concepts
- "Risk" represented by differences in LogN sigma (CV)
- Can also reflect "stretch" = [Plan LR – True Exp LR]
Capital Usage Costs

- One way to express "risk appetite" or "risk preference" or "emphasis"
- Determines which LOB pays how much for downside / volatility
- Must be calibrated to portfolio total
- Differences between (B) and (C) reflect "kurtosis penalty" — punishing tails

<table>
<thead>
<tr>
<th>3) Capital Usage Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOB 1</td>
</tr>
<tr>
<td>Required Capital Charge on Premium</td>
</tr>
<tr>
<td>Capital Usage Charge Adj Factor Due to Reserves</td>
</tr>
<tr>
<td>(a) Rental Fee</td>
</tr>
<tr>
<td>(b) Consumption Charge Within Required Capital</td>
</tr>
<tr>
<td>(c) Consumption Charge Beyond Required Capital</td>
</tr>
<tr>
<td>Required Charges Total</td>
</tr>
</tbody>
</table>

RAROC and RORAC
Two Axes of Capital Cost

- RORAC = Return on Risk Adjusted Capital
  - Most capital allocation approaches
  - Risk adjusted capital amount
  - Constant cost of capital rate
- RAROC = Risk Adjusted Return on Capital
  - Risk adjust the return
  - Only to the extent that capital amount does not reflect risk

<table>
<thead>
<tr>
<th>4) Portfolio Evaluation Metrics - RAROC</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOB 1</td>
</tr>
<tr>
<td>Premium</td>
</tr>
<tr>
<td>Required Capital</td>
</tr>
<tr>
<td>EVA</td>
</tr>
<tr>
<td>Usage Cost as % of Capital</td>
</tr>
<tr>
<td>Rental Fee</td>
</tr>
<tr>
<td>Consumption Charge</td>
</tr>
<tr>
<td>P [Exceeding Required Capital]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4) Portfolio Evaluation Metrics - RORAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOB 1</td>
</tr>
<tr>
<td>Premium</td>
</tr>
<tr>
<td>Required Capital</td>
</tr>
<tr>
<td>Return</td>
</tr>
<tr>
<td>Expected Capital Usage Cost</td>
</tr>
<tr>
<td>EVA</td>
</tr>
<tr>
<td>Usage Cost as % of Capital</td>
</tr>
<tr>
<td>Rental Fee</td>
</tr>
<tr>
<td>Consumption Charge</td>
</tr>
</tbody>
</table>
Examples

1) Bonehead RAROC: Capital charges (amounts) reflect exact opposite opinion of our volatility measure (sigma) – how does the RAROC correct for this?

2) VaR (99%) RORAC: Capital charge relativities based on standalone VaR (99%) for each LOB. How much “risk” remains unreflected – that is, how much do the returns have to vary?

Portfolio Mix Evaluation and Optimization

Roadmap for Portfolio Mix Evaluation

1. An Internal Risk Model Captures Product-Inherent Risk Features
2. Product Performance Simulation Produces Outcome Distributions
3. Capital Usage Costs Are Allocated To Segments
4. Multiple Possible Uses

Capital Usage Costs as an Expense Load that is a Function of Volatility & Capacity Occupying

Rating Agency Required Capital Constraints

Volatility Load

Fixed Income

Equity

Capital Risk Exposure Target Price Levels

Optimization Metric Reflects Company’s Risk Appetite
Portfolio Mix Evaluation

- Calibrate Total Capital Usage Cost to X% of Required Capital
- Can control emphasis of the RAROC formula:
  - Capacity-focused: Majority of Usage Cost comes from Capacity Charges
  - Volatility-focused: Majority of Usage Cost comes from Volatility Charges
  - Balanced: 50% from each

Portfolio Mix Model – Evaluation

Input

Output

- Portfolio Mix: Premium, Loss Ratios, Commission, Overhead
- Required Capital Factors: Premium And Reserves
- Capital Usage Cost Factors: Rental And Consumption

Perfect For What-If Analyses

Portfolio Mix Model – Optimization

Optimizer Inputs

Optimizer Output

- Segment Premium Constraints
- Optimizer Target: E.g., Maximize EVA
- Max Required Capital Constraint
- Optimizer Evaluates Thousands Of Alternative Mixes
- Optimal Portfolio Mix Given Constraints
- Evaluation Metrics For Optimal Mix: EVA, Capital Usage Cost
- Marginal Comparison With Starting Mix

Perfect For Strategic Directional Analysis
Summary

Risk Adjusted Cost of Capital

<table>
<thead>
<tr>
<th>Issue</th>
<th>How it Will Be Addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating Agency Required Capital is a Binding Constraint</td>
<td>Use Rating Agency Required Capital formula everywhere</td>
</tr>
<tr>
<td>But Rating Agency Capital Charges do not reflect Our Risks</td>
<td>Vary the Target Rates of Return instead of varying the capital amounts (RAROC)</td>
</tr>
<tr>
<td>Total Capital is really a Shared Asset simultaneously exposed by all P&amp;L's</td>
<td>Capital Usage Cost formula works as if Finance grants the P&amp;L's Letters of Credit:</td>
</tr>
<tr>
<td></td>
<td>- Assess a capacity charge (like an access fee), and</td>
</tr>
<tr>
<td></td>
<td>- a volatility charge (like a draw down of the LOC)</td>
</tr>
</tbody>
</table>

Sales Pitch: Why Consider This?

1. Complete framework that can handle both current approaches and future expansions
2. Accessible underlying philosophy
3. Reflects fundamental indivisibility of company capital
4. More realistic financial analogue than imputed equity flows = Letter of Credit
5. Ties to Finance Dept by using external required capital formulas
6. Adjusts for degree of risk reflected in external required capital formulas
7. Risk preferences are explicit
8. Reflects capacity occupation, volatility, risk preferences and correlations
Thank you for your attention.