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Basics of Capital Model

MAF Fall Meeting

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Basics of Capital Model - Agenda

- What is Capital?
- What is Risk?
- How do we model Economic Capital? - A Simple Model
- After you built the model - what do you do with it?
- Current ERM topics

Survey question

In terms of my experience and exposure to this type of topics:

1) I am a guru, in fact, I probably don't need to be here and just came for CE credits.

2) I have worked on a DFA / economic capital model before.

3) I've read some articles and papers about economic capital from the exams and just out of my own interest

4) Never heard of the term "economic capital"

What is Capital? - distinctions

- A.k.a. Equity or Surplus or Excess Fund
- Available Capital:
  - Asset minus Liability
  - Can be different depending on what accounting principles or regulatory definitions you are talking about
- Required Capital: Usually sets a “minimum”
  - Exists in regulated industry (such as US RBC)
  - Or threshold for determining credit rating (AM Best’s BCAR or S&P capital model)
- Economic Capital Need (or Risk Capital Need):
  - A figure that is calculated based on the company’s risk profile
  - “What do we think is an appropriate amount of “buffer” to ensure solvency of our company”

What is "Risk" then?

- "Risk… is the possibility or chance of loss, danger or injury"
- It could be:
  - Coming from many different sources
  - Internal or external to the organization
  - Quantifiable or non-quantifiable (but at least we try to quantify)
  - Short-term or long-term
  - Diversifiable or non-diversifiable (specific or systemic)
  - Material or non-material

What is "Risk" then?

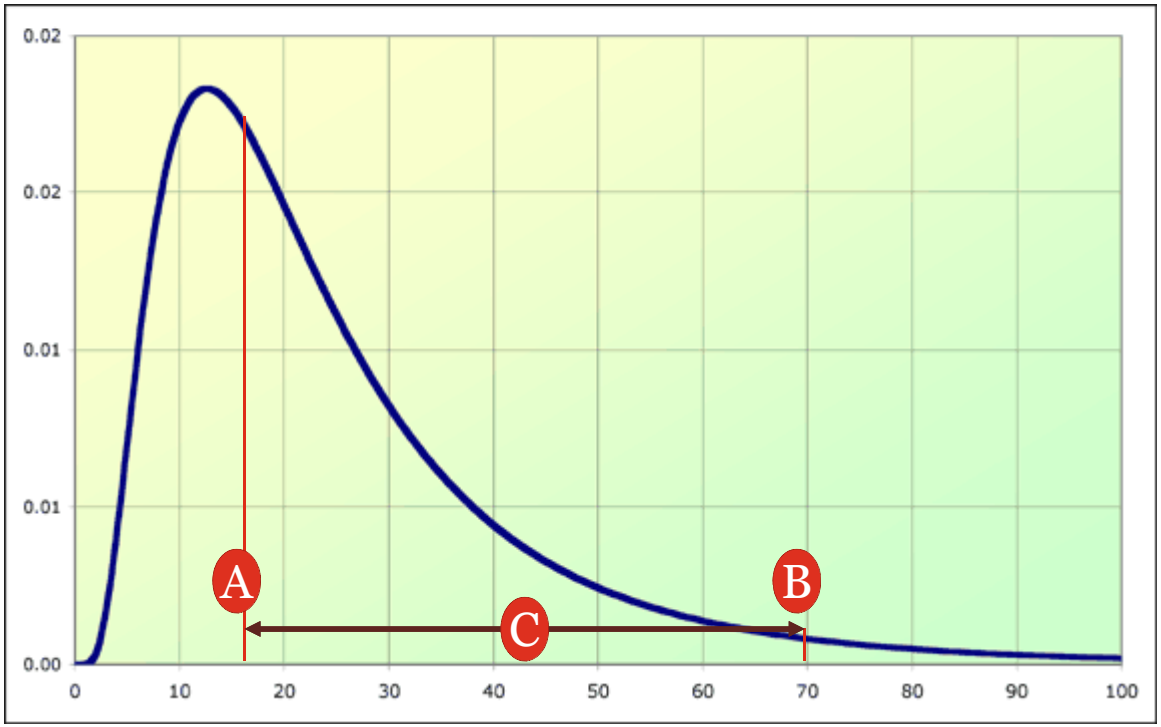
- With related to the risk capital / economic capital, risk means "chance of loss of the company value, or capital": the downside potential minus expected!
- Usually in the economic capital model, risk means the distance between mean and a value at a specified confidence level (VaR, TVaR…)

a) Mean = 17

b) Value at Risk

at xx%ile = 70

c) Risk Measure = 53



Simple Example

Important Considerations BEFORE Starting

Indicator	Severity	Frequency	Time Horizon
What are we measuring? (all options eventually come back to capital level)	What is the tolerable level of this selected "indicator"?	What is the tolerable frequency that the selected indicator hits the selected severity	What time horizon is the fund supposed to protect?

Extremity

- **Example of Target Capital Need: "We would like to have enough capital to protect our policyholders from a 1-in-200 year event in the next year"**
- **Confidence Level / Extremity**:
  - Solvency II guideline as well as some other territories' regulations: 1-in-200 year event
  - Rating agency models
- **Time Horizon**
  - 1 year vs. multiple years
  - Typically coincides with the planning or strategy cycle of a company

What Are Main Risks Facing a P&C Company?

Underwriting	Reserving	Asset & Credit	Operational
Risk that the next year's business result may deviate from plan	Risk that the eventual loss & expense may exceed carried reserves	Risk that the value of investment asset and receivables may deteriorate	Any other unplanned expense that may arise from operation
• Catastrophic events • Systemic losses • Unusual attritional / large loss activities • Reinsurance cost • Market cycle • Price inadequacy, etc.	• Excessive inflation • Judicial environment on certain claim types • Latent claims, etc.	• Risk free interest rate fluctuation • Stock market crash • Bond spread fluctuation • Liquidity • Reinsurer failure • Intermediary default	• Inadequate disaster recovery plan on the catastrophic events • People related (turn over, fraud, reputational) • System and process failure, etc.

Odds Insurance Co's Balance Sheet and Plan

- Balance Sheet at YE2011 for Odds Insurance Co.

Asset	900	Liability + Equity	900
Bond	700	Property Reserves	100
Stock	30	GL Reserves	300
Reinsurance Recoverable	150	E&O Reserves	200
Intermediary Receivable	20	Equity	300

- Their business plan for 2012 is:

2012 Business Plan	Planned NWP	Planned Non Cat NLR
Property	100	40%
GL	80	63%
E&O	50	55%
TOTAL	**230**	**51%**

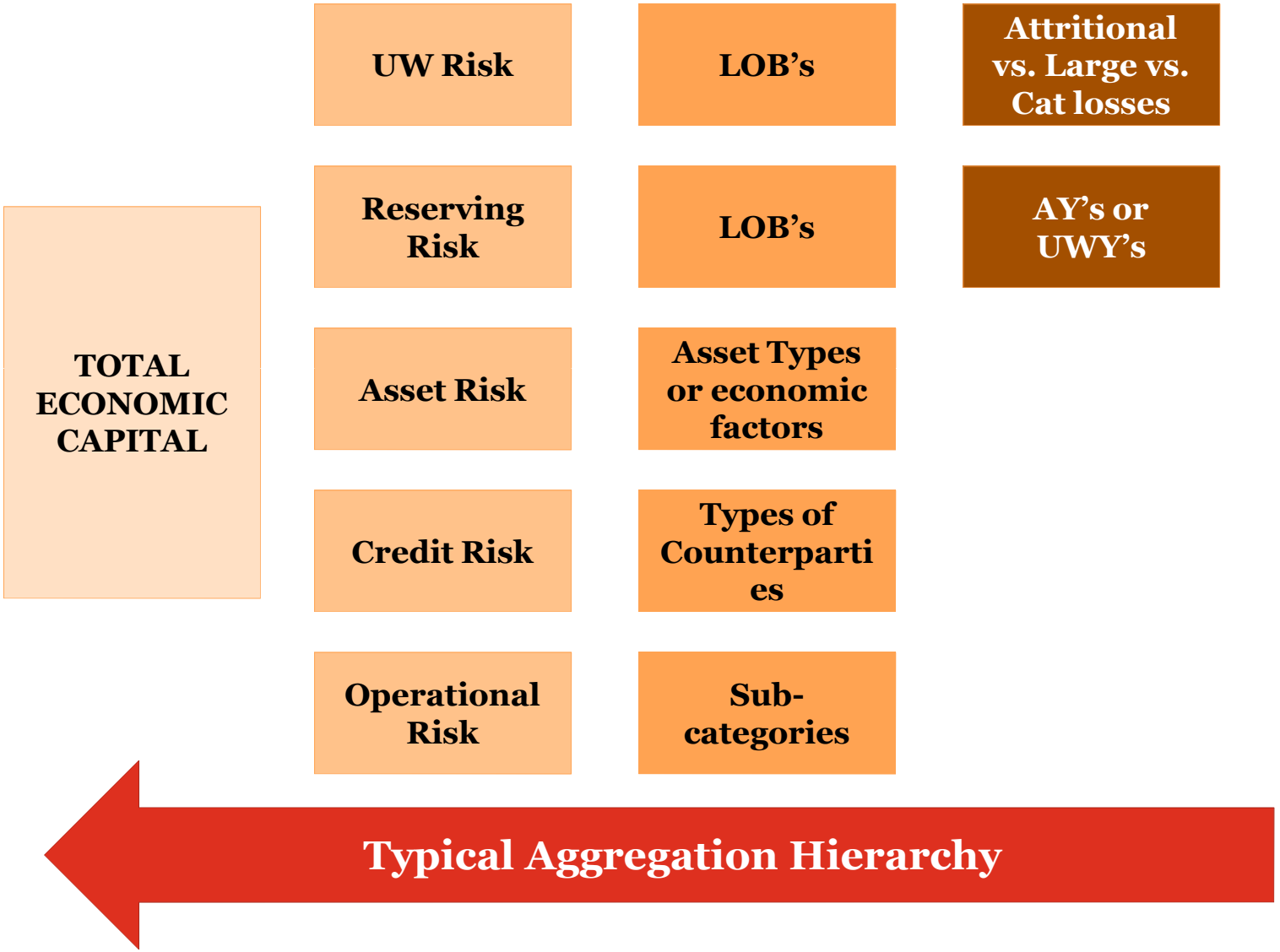
Let's Start from the Result…

- Based on the financials shown on the prior page + calibration standard of 99.5 %ile over 1 year, the capital need is calculated as below:

TOTAL ALL RISK CATEGORIES	Risk $	Allocated Risk $	Diversification Benefit	Risk Related To:
Underwriting Risk (Non-cat)	86	67	22%	Business plan
Reserving Risk	108	91	16%	Reserves
Asset Risk	105	74	30%	Investement
Credit Risk	53	30	44%	Receivables
Operational Risk	18	11	42%	Off BS
Total Undiversified	370			
Total Diversified Capital Need	**272**	272	**27%**	
Assuming 0% Correlation	182			

- The capital need for Odds Insurance Co covers ALL balance sheet items (except Equity, of course), the business plan and other off-balance sheet items that are not planned.

Capital Model in Summary



Underwriting & Catastrophe Risk

Underwriting Risk	Planned NWP	Planned Non Cat NLR	99.5%ile NLR	UW Risk Factor (non-cat)	Non Cat UW Risk	Cat Risk*	Total UW Risk $
Property	100	40%	70%	30%	30	40	53
GL	80	63%	103%	40%	32	-	32
E&O	50	55%	105%	50%	25	25	38
Total Undiversified	230	51%	89%	38%	87	65	152
Total Diversified	**230**	**51%**	**78%**	**26%**	**61**	**47**	**86**
Assuming 0% Correlation	230	51%	73%	22%	50	47	73
* Includes Cat Model output for property, and systemic event (like credit crunch) output from an internal model							

- The net LR distribution :
  - Company's historical LR's vs. volatility observed in the industry
  - Attritional vs. large loss vs. catastrophe losses
- Attritional losses: historical loss ratios and volatility around them
- Large losses: severity and frequency parameters
- Cat risk: Cat model output for natural catastrophes and terrorism

Reserving Risk

Reserving Risk	Gross Reserve	Net Reserve Central Estimate	99.5%ile Reserves	Reserving Risk Parameters	Reserving Risk $
Property	100	100	125	25%	25
GL	300	200	260	30%	60
E&O	200	150	210	40%	60
Total Undiversified	600	450	595	32%	145
Total Diversified	**600**	**450**	**558**	**24%**	**108**
Assuming 0% Correlation	600	450	538	20%	88

- Various stochastic reserving methods: Bootstrap, Mack, GLM, Hachmeister, Feldblum, and the list goes on… Consider several methods!
- Treatment of reserve margin

Asset and Credit Risks:

- **Asset Risk:**
  - Increasing use of stochastic method (Economic Scenario Generator)
  - But scenario based approaches are also used

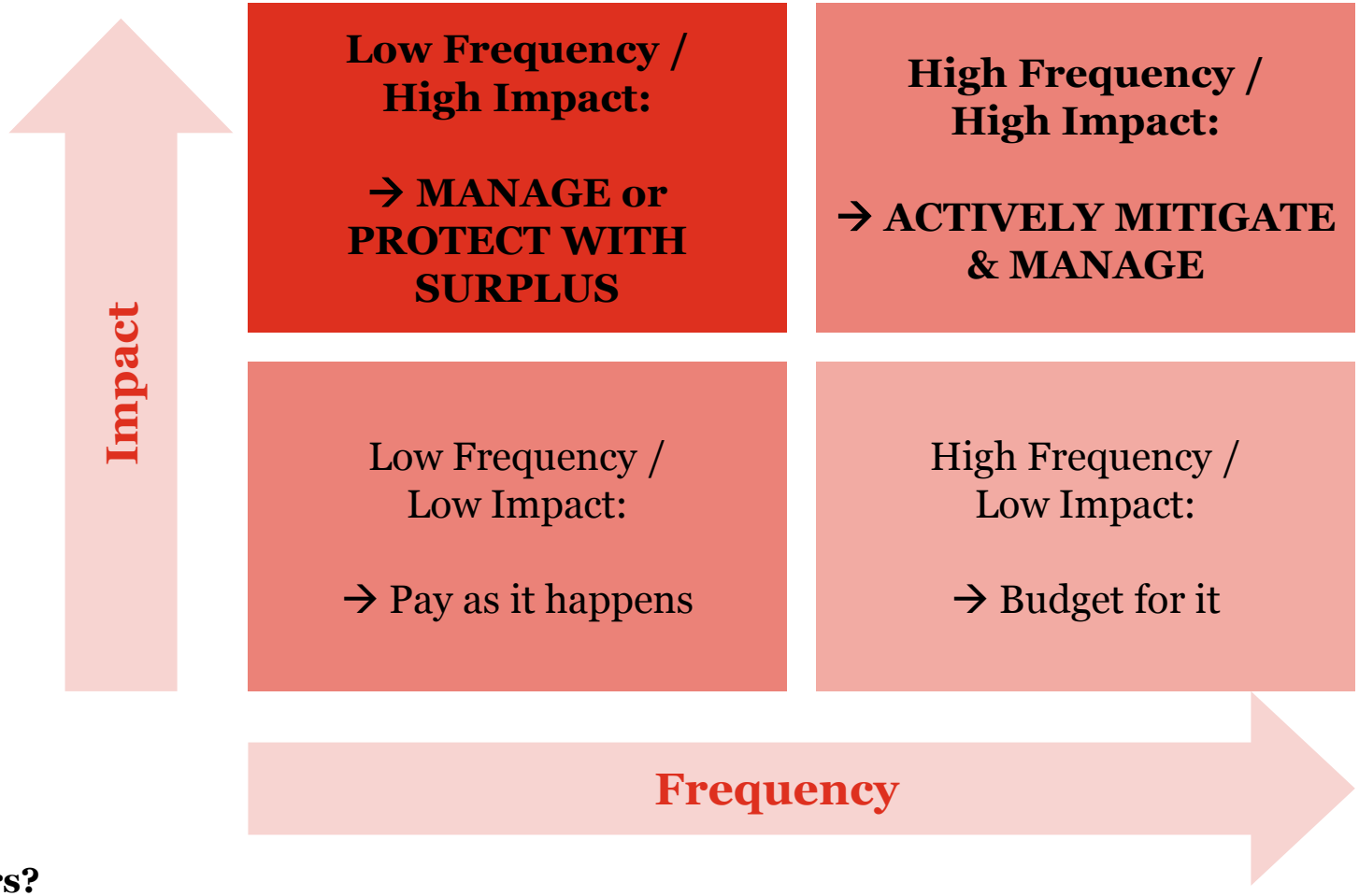
Asset Risk	Book Value	Stress Scenarios	Asset Risk $
Interest Rate Risk	700	5% increase in rate	100
Equity Market Risk	30	40% drop in market	12
Total Undiversified	730		112
Total Diversified	**730**		**105**
Assuming 0% Correlation	730		101

- **Credit Risk:**
  - The most significant one for P&C companies is default or dispute risk on reinsurance balance.
  - Broker balance or any asset items that are held by third party and owed to the company, and not fully collateralized.

Credit Risk	Book Value	Stress Scenarios	Credit Risk $
Reinsurance Default Risk	150	Default on biggest RI balance	50
Intermediary Default Risk	20	20% uncollected	4
Total Undiversified	170		54
Total Diversified	**170**		**53**
Assuming 0% Correlation	170		50

Others

- **Operational Risk:**



- **Others?**
  - Liquidity risk, reinsurance risk, group risk, and any others that are applicable and material to the company's operation

Two Typical Methods for Quantifying Risk

Stochastic Modeling

- Generates "continuous distribution"
- Usually based on data
- Need parameters and shape

- Pros: Once we have parameters and curve shape, we can easily pinpoint specific VaR needed + easier correlation calculation
- Cons: Quality of historical data – are they reliable when we try to model tail ends of distribution?

Scenario/Stress Testing

- Stress scenarios that are extreme enough for company's operations (usually hypothetical assumptions)
- Used when data is sparse
- Methods that some regulators subscribe to (Canada, UK, China)

- Pros: Easier to understand for non-actuaries.
- Cons: How comprehensive are they? How do we know if the scenarios are extreme enough?

Diversification

- To recognize diversification between risks (bad things don't always happen at the same time)
- Various methods - correlation matrix, copula, ESG-initiated.
- Simple, widely-used approach : a two dimensional correlation matrix
  - Start with High/Medium/Low assumptions – easier to engage people this way
  - Then test various percentage figures for High/Medium/Low correlation (based on benchmark, company data, etc)
  - Check if the matrix is positive definite!

	Underwriting Risk	Reserving Risk	Asset Risk	Credit Risk	Operational Risk
Underwriting Risk	100%				
Reserving Risk	Hi	100%			
Asset Risk	Lo	Med	100%		
Credit Risk	Med	Lo	Med	100%	
Operational Risk	Med	Med	Med	Med	100%

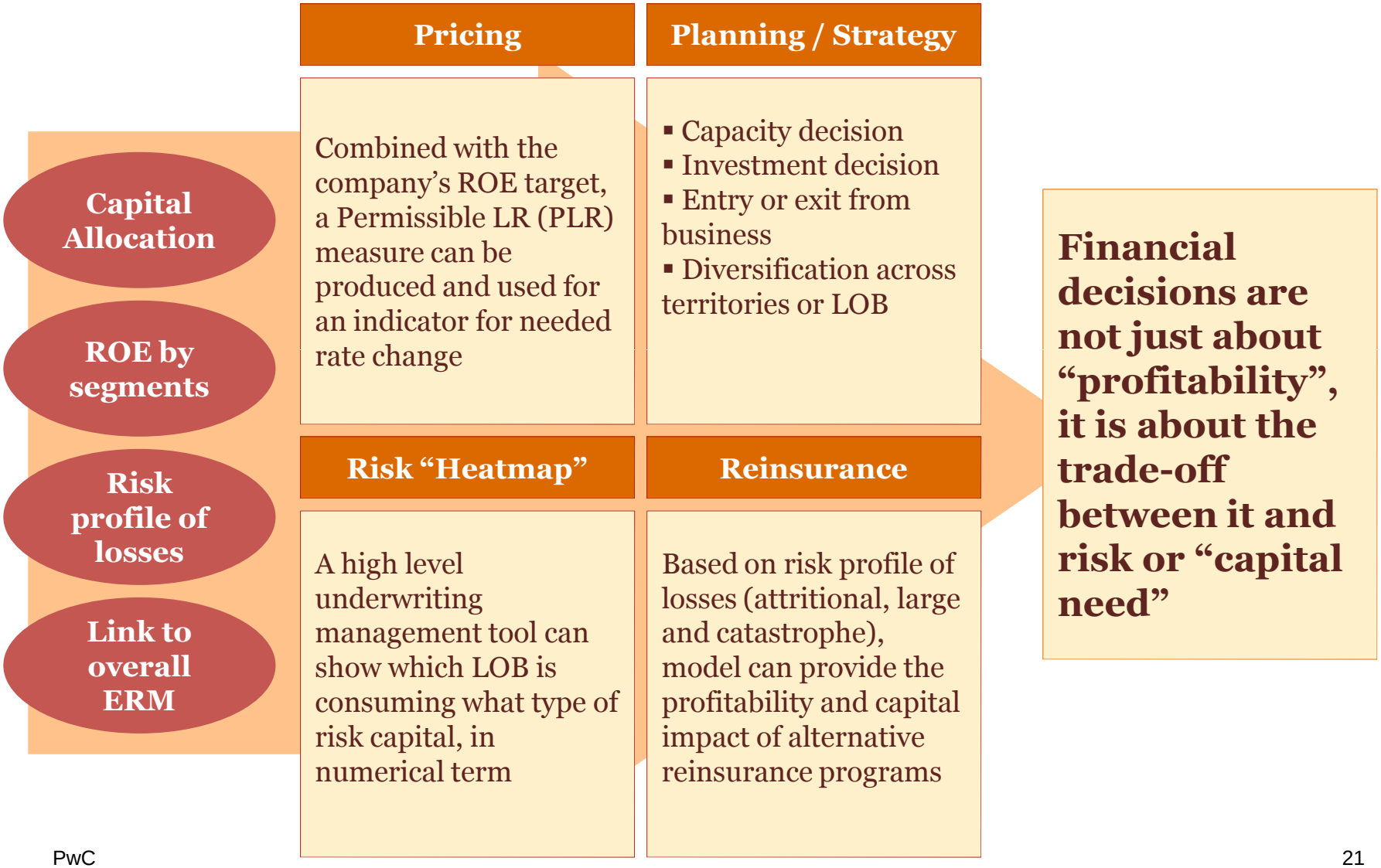
	Underwriting Risk	Reserving Risk	Asset Risk	Credit Risk	Operational Risk
Underwriting Risk	100%	75%	15%	40%	40%
Reserving Risk	75%	100%	40%	15%	40%
Asset Risk	15%	40%	100%	40%	40%
Credit Risk	40%	15%	40%	100%	40%
Operational Risk	40%	40%	40%	40%	100%

Related tools and mechanisms…

- **DFA models**
  - A complex model that has higher computing power, many variable options and sophisticated correlation structure built in and can interface with catastrophe models and ESG and project forward financials
  - BUT, you still need to feed it with parameters and assumptions to make the results reasonable
- **Catastrophe models (RMS, EQECAT, AIR, or internal models)**
- **Economic Scenario Generator (ESG)**
  - Stochastic model that simulates the macro-economic variables, such as interest rate, inflation, stock market, unemployment, etc
  - In a sophisticated DFA model, an ESG is linked in to model various risk components such as asset, insurance and default risks.

After You Built the Model

Is it Useful (outside keeping regulators happy)?



...in Summary

- **Capital model isn't always complicated (and shouldn't be):**
  - **Structure**: as simple or as complex as we want –think of the benefits of making the model complex: What do you use the model for? Is it aligned with how you operate and monitor the business?
  - **Parameterization:** Stochastic modeling concept
  - **Principle of "Proportionality"**
- **When done right (right level of granularity and good parameters), it <u>is</u> useful:**
  - For practically all financial decisions and risk mitigation efforts, which have potential capital vs. cost impact
  - With US ORSA going into effect in 2015, quantification of risk, along with a sound risk management framework, is becoming more important

Thank you, and Questions?

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