Capital Modelling
Capacity Building in Non-Life Industry
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Agenda

• What is Capital?
• Why we need capital?
• Types of Risk
• Calculation of Capital
• Capital Requirement
• Q&A
1. What is Capital?
1. What is Capital?

- Capital has various definitions ranging from financial capital to human capital.

- In the broadest sense, capital is a factor of production, used to produce goods or services, that is itself not significantly consumed in the production process.

- In financial sense, capital may be interpreted as the equity on the company’s balance sheet.
1. Types of Capital

- **Accounting Capital**
  - The amount of ‘shareholders’ funds’ on the balance sheet.
  - It is calculated in accordance with the Accounting Standards – International or Local. For example, IFRS published by IASB.

- **Economic Capital**
  - “Economic Capital” is often based on a true market valuation of the company’s assets and liabilities, which is a complex task for an insurance company.
  - It may exclude intangible assets such as future profits or goodwill.

- **Regulatory Capital [Solvency Capital]**
  - Regulatory Capital is the minimum amount of capital that insurer need to hold to be able to write new business or run-off existing one.
  - It may be calculated using a simple formula or a more complicated risk-based approach (UK & EU).

\[
\text{Capital} = \text{Total Assets} - \text{Total Liabilities}
\]
2. Why we need capital?
2. Unexpected Events

2001
World Trade Centre - US$21bn

2004 - 05
Hurricane Ivan - US$11bn
Hurricane Charley - US$8bn
Hurricane Katrina - US$45bn
Hurricane Wilma - US$10bn
Hurricane Rita - US$10bn

2007
UK Floods – £3.5bn

2011
Japan Earthquake / Tsunami – >US$ 35bn

* Expected insured loss as per Aon Worldwide

Insufficient funds will lead to insolvency
2. Why is Capital needed?

• Other Reasons
  – Portfolio Monitoring
  – Financing new lines of business
  – Expansion of existing lines
  – Merger & Acquisitions
  – Working Capital
  – To demonstrate financial strength to rating agencies, policyholders, etc.
2. Example

Here is a simple example

<table>
<thead>
<tr>
<th></th>
<th>Normal Year</th>
<th>Extreme Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Earned Premium</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Net Incurred Claims</td>
<td>(50)</td>
<td>(100)</td>
</tr>
<tr>
<td>Expenses</td>
<td>(20)</td>
<td>(20)</td>
</tr>
<tr>
<td>Commission</td>
<td>(25)</td>
<td>(25)</td>
</tr>
<tr>
<td>Underwriting Profit</td>
<td>5</td>
<td>(45)</td>
</tr>
<tr>
<td>Investment Income</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Profit b/f Tax</td>
<td>10</td>
<td>(40)</td>
</tr>
<tr>
<td>Tax</td>
<td>(3)</td>
<td>0*</td>
</tr>
<tr>
<td>Profit after Tax</td>
<td><strong>7</strong></td>
<td>(40)</td>
</tr>
</tbody>
</table>

* Tax credit of 12 maybe received depending on the local tax regulation

• If things turn out as planned (Normal Year) we make some profit and no capital is required, but..

• It is possible we have a bad result (Extreme Year) and lose money. Here the shareholders needs to provide 40 units of capital to ensure we are still solvent.

* Capital funds unexpected events
## 2. Users of Capital

<table>
<thead>
<tr>
<th></th>
<th>Why do they care?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulators</td>
<td>Will they pay policyholders?</td>
</tr>
<tr>
<td>Policyholders</td>
<td>Can they pay future claims?</td>
</tr>
<tr>
<td>Rating Agencies</td>
<td>What is their credit worthiness? (for rating bonds, etc)</td>
</tr>
<tr>
<td>Debt Holders</td>
<td>Will we get our money back?</td>
</tr>
<tr>
<td>Creditors</td>
<td>Will we be paid?</td>
</tr>
<tr>
<td>Employees</td>
<td>Jobs and pension security</td>
</tr>
<tr>
<td>Analysts</td>
<td>Recommendations to investors</td>
</tr>
<tr>
<td>Shareholders</td>
<td>What return to expect?</td>
</tr>
</tbody>
</table>
2. Relationship between Risk, Capital and Return

How much risk do you want to take on?

Risk

How much capital do you want to protect against losses?

Capital

How much profit can you make, given the level of risk with the capital you have?

Return
3. Types of Risk
3. Key Risks

<table>
<thead>
<tr>
<th>Category</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>• Equities</td>
</tr>
<tr>
<td></td>
<td>• Interest rates (Asset Liability Mismatch)</td>
</tr>
<tr>
<td></td>
<td>• Alternative Assets</td>
</tr>
<tr>
<td></td>
<td>• Property</td>
</tr>
<tr>
<td></td>
<td>• Liquidity Risk</td>
</tr>
<tr>
<td></td>
<td>• Foreign Exchange Rate risk</td>
</tr>
<tr>
<td>Operational</td>
<td>• IT failure</td>
</tr>
<tr>
<td></td>
<td>• Litigation</td>
</tr>
<tr>
<td></td>
<td>• External factors such as acts of terrorism, war etc</td>
</tr>
<tr>
<td></td>
<td>• Major failures in controls, process and people, such as fraud etc</td>
</tr>
<tr>
<td></td>
<td>• Regulatory Breach</td>
</tr>
<tr>
<td>Underwriting</td>
<td>• Current and future year net non-cat losses</td>
</tr>
<tr>
<td></td>
<td>• Risk that pricing margin in insufficient</td>
</tr>
<tr>
<td></td>
<td>• Relates to new business plus full run off</td>
</tr>
<tr>
<td></td>
<td>• Exposure to losses from Catastrophe events</td>
</tr>
<tr>
<td>Reserve</td>
<td>• Volatility of best estimate net claim reserves, due to inflation etc</td>
</tr>
<tr>
<td></td>
<td>• Relates to prior accident years</td>
</tr>
<tr>
<td></td>
<td>• Risk that best estimate reserve ultimately prove to be insufficient</td>
</tr>
<tr>
<td>Credit</td>
<td>• Reinsurer Default</td>
</tr>
<tr>
<td></td>
<td>• Counterparty Loans</td>
</tr>
</tbody>
</table>

Common classification covering all relevant risks
3. Market Risk

Market risks are the risks related to changes in investment market values or other features correlated with investment markets, such as interest and inflation rates and its impact on insurance business.

- **Inflation Risk**: Uncertainty about future inflation especially for claims will affect the actual profit of claims made.

- **Currency Risk**: Insurers having operations in multiple countries are exposed to currency risk.

- **Investment Risk**: Investments, such as equity, property, etc. are subject to risks of fluctuation in their market value and correlation.
3. Operational Risk

- Operational risk refers to the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events.

- Inadequate or failed internal processes include:
  - Mismanagement, for example: inappropriate actions of the Board of directors / staff, failure of the appropriate management systems and control or administrative complexity etc.
  - IT failure
  - Inadequate risk control measures
  - Fraud

- Regulatory breach

- External risk includes external events, such as storm, fire, flood, or terrorist attack
3. Credit Risk

• Credit risk refers to the risk of loss if another party fails to perform its obligations or fails to perform them in a timely fashion. For general insurance companies key counterparties include reinsurers, brokers, policyholders, investment managers and companies.

• Reinsurance credit risk is usually the largest component of credit risk and deals with the potential bad debt on reinsurance assets. Things to consider here are:
  – gross and net losses
  – link increased probability of reinsurance failure to extreme losses
  – concentration risk
  – reinsurance failure rates should allow for the risk of downgrade
  – duration of recoveries
  – treatment of any intra group reinsurance
3. Liquidity Risk

- Liquidity risk is the risk that the insurer, although solvent, does not have available sufficient financial resources to enable it to meet its obligations as they fall.
  - Planning & Cashflow
  - Unexpected Events
  - Post Loss Environment
3. Insurance Risk – Reserve & Underwriting

- Insurance risk is defined as the risk of loss arising from the inherent uncertainties about the occurrence, amount and timing of insurance liabilities and premiums.

- It can be further split into following 3 categories:
  - Reserving
  - Underwriting
  - Reinsurance
3. Reserving Risk

- Reserving risk is the risk that claims reserves set aside for the business earned up to the end of the financial year-end are inadequate to meet the claims incurred.

- Reserving risk also includes over-reserving if it causes a loss.

- When assessing reserving risk, insurance companies should consider:
  - Best Estimate Reserves – Methods & Assumption, adequacy
  - Reserve margins – Excess amount of reserves over and above best estimate reserves
  - Investment income/discounting of reserves
  - Possibility of latent claims
  - Impact of regulatory changes
  - Impact of high and low inflationary environment
3. Underwriting Risks

- Underwriting risk relates to losses arising from all the future years of business that will be earned or written in next financial year. It is also known as premium risk sometimes.

- When assessing underwriting risk, insurance companies should consider:
  - Impact of underwriting cycle [Premium Rates vs Business Volume]
  - Volatility of Claims severity and frequency which may be influenced by:
    - Claims inflation
    - Types of policy / cover and its characteristics
    - Policyholders characteristics of and their attitude to claiming
    - Economic conditions
    - Crime rates etc.
    - Anti-selection and Moral Hazard
    - Claims handling practices
  - Reasonableness of the underwriting business plan
  - Exposure to natural and man made catastrophes,
3. Reinsurance Risk

- Risks associated with the use of, and potential reliance on, reinsurance linked with underwriting and reserving risk within insurance risk. Reinsurance is a Risk Management tool and the intent of buying reinsurance is to reduce risk.

- However, under reinsurance, there may be associated risks and uncertainties arising from:
  - Inadequate and non matching reinsurance
  - Availability and cost of the desired reinsurance
  - Post loss impact on cost and availability
  - Excessive amount of Reinsurance or reinsurance that is poor value for money
  - Failure to comprehend the coverage / limits of a reinsurance arrangement.
  - Solvency position or credit worthiness of the reinsurer.
  - Concentration of reinsurers
  - Reinsurance dispute over claims payments
3. Other Risks

• **Expense risks**
  
  Expense risks include the risk of higher than expected levels of expense inflation, mismatching between the timing and level of expense outgo and charge income and inadequate spreading of fixed expenses.

• **Business Volumes**
  
  – If an insurance company sells lower than expected volumes of business, then it is at risk that its fixed expenses will not be met.
  
  – If higher than expected volumes of business are sold, then the company might face solvency issues arising from new business strain.
3. Diversification & Dependencies

• Diversification reduces risk as the capital required for two or more risks taken together is generally less than the sum of the capital requirements of the individual risks. This can be present be
  – Between policies in a portfolio,
  – Between different types of portfolio,
  – Across time and geographical boundaries,
  – Between various risk types, and so on.

• It is the fundamental principal of insurance
3. Dependencies Between Various Risks

- Dependency affects the reduction bought by diversification; the more interdependent the risks, the less the reduction in risk from diversification. Dependency refers to an increased probability of an event given that another event is known to have occurred.

- For example, reinsurance failure and high gross claims may be dependent because both can in some cases be caused by the same weather events; and a higher frequency of losses may present evidence that severity will also be higher, with no causal chain.

- Correlation is only one specific measure but dependency at more severe scenarios or at tails is more important. For example, when there are large losses, higher reinsurance failure or dispute are more likely than in “normal times”.
4. Calculation of Capital
4. How Do You Calculate Surplus Capital?

All capital frameworks share a consistent approach.

- Capital (Surplus Assets)
  - Share Capital
  - Retained Earnings
  - Debt Capital

LESS

- Restricted Assets

EQUALS

- Available Capital

LESS

- Regulatory Capital Requirement

EQUALS

- Surplus Capital
4. Complexity Chart in calculation of Capital

**Basic**

**Accounting - Capital Held**
Shareholders funds – primary driver of all capital measures

**Solvency I (Regulatory) Capital Requirement**
Higher of;
- 16% Earned / Gross Written Premiums X Reinsurance
- 23% Claims Incurred Ratio

**Rating Agencies Capital Requirement**
Risk Charges based on simple formulae applied to:
- Premiums – by line of business
- Assets – by asset category
- Reserves – by line of business

**Complex**

**Internal Capital Assessment, and now, Solvency II**
Models all risks of the business and calculates the amount of capital needed to be 99.5% certain of paying all policyholders.
4. Capital Calculation – Solvency II

Current regulatory framework (Solvency I)
- Booked Reserves per IFRS
- MCR – Minimum Capital Requirement based on simple formulae
- ICA – Internal Capital Assessment

Proposed Solvency II regulatory framework
- SCR: Solvency Capital Requirement, calculated using standard formula or Internal Model
- MCR: Minimum Capital Requirement based on a proportion of the SCR
- Risk Margin
- Discounted Best Estimate

Not drawn to scale

- Under Solvency II, the valuation of technical provisions follows the transfer value principle, under which the value of technical provisions shall correspond to the current amount the insurer would have to pay if was to transfer its insurance obligations immediately to another insurer (reinsurer).

- To achieve a valuation consistent with this principle, the technical provisions are calculated as a best estimate plus a risk margin.

**Best Estimate:**
- It corresponds to the probability-weighted average of future cash-flows, taking into account of the time value of money.

**Risk Margin:**
- The risk margin represents the cost of providing an amount of eligible own funds equal to the Solvency Capital Requirement necessary to support the insurance and reinsurance obligations over the lifetime thereof.

“Net technical provisions” refers to technical provisions net of reinsurance recoverable.
4. Modelling - Deterministic vs. Stochastic

- **Deterministic Model**
  - A *deterministic model* is one where the variables (eg. Premium, Claims etc) are fixed at the outset of running the model.
  - The result of running the model is a single outcome.
  - Only few discrete scenarios (worst case, most likely case, best case) can be determined.

- **Stochastic Model**
  - A *stochastic model* estimates the significant variables by assigning each of them a probability distribution.
  - The model simulates the variables with their predefined distributions.
  - The output of the model is a set of as many future possible scenarios (simulations) as the user wants
  - Stochastic model can be both dynamic or silo.
4. Stochastic Modelling

- In stochastic risk modeling uncertain future outcomes represented using a range of possible values known as random variables, and all of these variables are associated with a probability distribution.

- In practice to calculate different risk types the following procedure are taken,
  - Derive the appropriate distribution for the net loss
  - To calculate the 99.5% value at risk (used in solvency 2) check the worst 0.5\textsuperscript{th} percentile value from the distribution.
  - Calculate the difference between the mean of the distribution and the 99.5% VAR. Any losses generated at the mean level is expected, losses exceeding the mean are treated as risk amount.
4. Stochastic Capital Model Framework

**Economic Scenario**
- Price Inflation
- Foreign Exchange Rates
- GDP
- Yields

**Underwriting Risk**
- Premium
- Claims
- Claim Payment Pattern

**Catastrophe Risk**
- Losses

**Reinsurance**
- Premium
- Recoveries

**Credit Risk**
- Reinsurance Default

**Market Risk**
- Profit / Loss
  - Asset Value

**Reserve Risk**
- Prior Year Reserve
- Reserve Volatility
- Reserve Payout pattern

**Net Underwriting Risk**
- Reserve for Future Years

**Simulated P&L Account**
- Simulated Balance Sheet Account

**Reserve for Future Years**
- Net Underwriting Risk
4. Value at Risk

• A risk measure.

• Value-at-Risk (VaR) is the loss at a predefined confidence level (e.g. 99.5%).

• Thus if the company holds a capital of VaR,
  – it will remain solvent with probability of the confidence level (e.g. 99.5%) and
  – Will be insolvent with probability of one minus the confidence level (e.g. 0.5%).

• Another way to explain VaR is by looking at for example 10000 (simulated) losses.
  – VaR would be set equal to the 50th largest loss (assuming a confidence level of 99.5%)

• The Solvency II and ICA capital assessments use a VaR measure (probability of ruin measure) to determine the amount of Total Resources Required.
4. Probability of Ruin

- **Probability of Ruin**
  - The chance that the insurance company will have insufficient assets to meet its liabilities at some point.
  - In simplest terms, it is defined as:

  \[
  \text{Probability of Ruin} = \text{Probability of } [(\text{Surplus}_{t-1} + \text{Income}_t - \text{Expenses}_t) < 0]
  \]

  - In other words, a 0.5% probability of ruin means we have insufficient funds, to pay our policyholders / creditors, once in every 200 years.
4. Risk Calculation

Probability distribution function

Mean

VaR

Risk Amount

99.5% confidence level

Loss
5. Capital Requirement
   European Perspective
5. Solvency I

• Solvency I
  – Current EU level regime for the prudential supervision of insurers dates back to the 1970s.
  – Capital requirements are calculated by a simple formula - usually based on a maximum of either percentage of premiums or claims, with no attempt made at a realistic assessment of risk.
  – The measure can seem counter-intuitive. Increasing profits by raising premium rates will drive up the capital requirement.
  – Many regulatory bodies, including the FSA in the UK have moved to a more accurate assessment of risk, based on sophisticated internal models and stress tests – known as the ICAS regime.

• ICAS
  – The ICAS regime supplements the minimum capital requirement of Solvency I and the Enhanced Capital Requirement (ECR)*.
5. Solvency II

- Three Pillar approach – Measure, Manage and Report
- A principles-based approach which create Pan-European regulatory regime for capital adequacy effective from January 2013 [Proposed]
- It creates harmonisation across the EU Creates and balance between protection of policyholders and encouraging efficient operations of companies
- Changes the basis of calculating insurance liabilities for regulatory purposes

“Solvency II is not just about capital, it is a change of behaviour” – Thomas Steffen, Chairman of CEIOPS

Solvency II is a fundamental overhaul of capital adequacy regime
5. Overview of 3 Pillars of Solvency II

**Pillar I**
Quantitative Requirements

- Calculation of technical provisions
- "Prudent person" approach to investments
- Solvency capital calculation:
  - SCR and MCR
  - Internal model vs. standard approach

**Pillar II**
Qualitative Requirements and Supervision

- Enhanced Risk Management system
- Owned by Senior Management
- Own Risk and Solvency Assessment (ORSA)
- Internal Audit function
- Actuarial function
- Capital add-ons
- Outsourcing

**Pillar III**
Prudential Reporting and Public Disclosure

- Reporting to the supervisors
- Annual publicised Solvency and Financial Condition Report
- Link with IFRS 2

**Group Supervision**: Groups are recognized as economic entities

**MEASURE**

**MANAGE**

**REPORT**
5. So is it all about Compliance and Capital?

Well, it can be answered in one line stating:

Solvency II focuses on mitigation of risks through better risk management rather than simply increasing capital.
### 5. SCR vs. MCR

<table>
<thead>
<tr>
<th>SCR</th>
<th>MCR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acronym</strong></td>
<td>Solvency Capital Requirement</td>
</tr>
<tr>
<td><strong>Definition / Purpose</strong></td>
<td>The target level of capital below which companies may need to discuss remedies with their regulators</td>
</tr>
<tr>
<td><strong>Calculation</strong></td>
<td>Prescribed standard formula(^1) or a company’s internal model</td>
</tr>
<tr>
<td></td>
<td>Simple factor-based formula c. 25% to 45% of the SCR(^2)</td>
</tr>
</tbody>
</table>

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1. Not yet decided
2. Expected to be in the said range as per QIS5 report
## 5. Solvency II vs. Basel II

<table>
<thead>
<tr>
<th></th>
<th><strong>Solvency II</strong></th>
<th><strong>Basel II</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target</strong></td>
<td>Insurers based in EU</td>
<td>Banks globally</td>
</tr>
<tr>
<td><strong>Objective</strong></td>
<td>Protect policyholders against bankruptcy</td>
<td>Reduce systemic risk in the banking system</td>
</tr>
<tr>
<td><strong>Scope</strong></td>
<td>Applies economic principles to both assets and liabilities</td>
<td>Concentrates primarily on assets</td>
</tr>
<tr>
<td><strong>Main risks covered</strong></td>
<td>Underwriting, counterparty default, market &amp; ALM, operational</td>
<td>Credit, market (as per BI), operational</td>
</tr>
</tbody>
</table>
Questions ???