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47 OF, Solvency II Internal Models

Moderator:
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Presenter:
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Agenda

1. Regulatory approval requirements (continued)
   - Calibration & statistical quality
   - P&L attribution
   - Governance
   - External models

2. Approval process & EIOPA guidelines

3. Implications - contrasting EU & US
   - Valuation models
   - Capital levels
   - Total balance sheets
   - Liability valuation
   - Equivalence
1. Regulatory approval requirements (continued)

... just because a model is used doesn’t mean it’s robust and stable!

So there are other requirements:
- Documentation
- Validation
- Calibration
- SQS
- P&L attribution
**Calibration & statistical quality**

Solvency II Directive

The statistical quality standards test requires the internal model, and in particular the probability distribution forecast underlying it, to comply with certain criteria.

The methods used to calculate the probability distribution forecast should be based on adequate, applicable and relevant actuarial and statistical techniques, and should be consistent with the methods used to calculate technical provisions.

**Article 121**

An insurer must be able to use the outputs of the internal model to calculate the SCR in a manner that provides policyholders and beneficiaries with a level of protection equivalent to that prescribed for the SCR in Article 101, being a 99.5% VaR of basic own funds over a one year period.

**Article 122**

**Calibration & statistical quality**

Example of calibration & statistical tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Calibration Check</th>
<th>Statistical Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield curve</td>
<td>Are appropriate rates being used as risk-free rates?</td>
<td>Are the implied correlations from the output consistent with the calibration?</td>
</tr>
<tr>
<td>£100=£100</td>
<td></td>
<td>Is the asset growing at an appropriate rate?</td>
</tr>
<tr>
<td>Equity volatility</td>
<td>Are the market equity volatilities appropriate? Has the model been calibrated to the right points on the volatility surface?</td>
<td>Does the model reproduce the equity volatilities it has been calibrated to for the important points on the volatility surface?</td>
</tr>
<tr>
<td>Swaption volatility</td>
<td>Are the market swaption volatilities appropriate? Has the model been calibrated to the right points on the volatility surface?</td>
<td>Does the model reproduce the swaption volatilities it has been calibrated to for the important points on the volatility surface?</td>
</tr>
<tr>
<td>Property volatility</td>
<td>How has the property volatility been derived? How does it compare to other ESG providers?</td>
<td>Does the model reproduce the property volatilities for the important maturity dates?</td>
</tr>
<tr>
<td>Correlation</td>
<td>How have the correlations between asset returns been derived? How do they compare to other ESG providers?</td>
<td>Does the model reproduce the correlations between asset returns stated in the calibration document?</td>
</tr>
</tbody>
</table>
**P&L attribution**

**Solvency II Directive**

Demonstrate how the categorization of risk chosen in the internal model explains the causes and sources of profits and losses. The categorization of risk and attribution of profits and losses shall reflect the risk profile of the insurance and reinsurance undertakings.

*Article 123*

**How do you interpret the requirement?**

- For each level of granularity, compare the actual profit or loss against the distribution of profit or losses projected by the model.
- To support management in understanding the drivers of profitability.
- To validate the assumptions in the model against emerging experience.

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**P&L attribution**

**Definition of Profit**

- Solvency II
- Accounting e.g. GAAP
- Management e.g. Economic

**Granularity**

- By Entity, Division or LOB
- Insurance, Investment or operational results

**Historical Data**

- Current Year / Prior Years

**Challenges**

- Business Plan and Capital Assessment may not be joined up
- SII analysis may not be seen as value add by management
- Allocation of investment, expenses or reinsurance may be arbitrary
- Test increasingly spurious at lower levels of granularity
- What trigger levels? Trends or year on year deviations?
**Governance**

A robust system of governance for the internal model which forms part of the overall system of governance of the undertaking is in place

- Set up of governance functions
- Clear allocation of responsibilities
- Education and training
- Guideline and procedures
- Framework for close liaison with Actuarial function and users

An appropriate pre-application process is in place for submission of Internal model application for approval and requirements for internal model approval are monitored on an on-going basis.

- IM application approval
- Formal documentation
- Monitoring compliance
- Procedures to assess materiality of non-compliance
- Management plans to address non-compliance
- Reporting

Design and operation of the internal model is appropriately documented

- Documentation framework
- Documentation governance
- Policies and procedures

**Governance**

There are appropriate governance and approval requirements for internal model changes

- IM change policy
- Approval and validation of changes
- Change documentation
- Reporting

The design and parameterisation of the internal model reflect the undertakings risk profile

- Alignment to material risks
- Review of IM design
- IM testing and validation

IM is based on stable platform

- Back-up;
- Recovery of the system;
- Storage of previous system;
- Version control; and
- Audit trail of internal model changes

There are sufficient resources to develop, monitor and maintain the internal model

- Conflicts of interest
- Sufficiency of resources
- Appropriateness of skills and experience
- Key staff dependencies

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**Governance**

<table>
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<tr>
<th>Timely calculated outputs of the internal model are used in the undertakings decision making processes and to meet supervisory reporting requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Model uses</td>
</tr>
<tr>
<td>• Design and frequency of IM outputs</td>
</tr>
<tr>
<td>• Monitoring of appropriate time lag for data and IM outputs</td>
</tr>
<tr>
<td>• Supervisory reporting timetable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The Board receives appropriate and adequate management information to assess the ongoing appropriateness of the design and operation of the internal model</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Performance of the internal model;</td>
</tr>
<tr>
<td>• Actual or expected areas of non-compliance with internal model approval requirements;</td>
</tr>
<tr>
<td>• Areas of improvement;</td>
</tr>
<tr>
<td>• Changes in undertakings risk profile</td>
</tr>
<tr>
<td>• Compliance with policies</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>The governance of Group IM is integrated with the entity level IM governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Coordination between the undertakings and entities in</td>
</tr>
<tr>
<td>• Internal reporting framework</td>
</tr>
<tr>
<td>• Alignment with the Group policies</td>
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</table>

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**External models**

**Solvency II Directive**

The use of a model obtained from a third-party shall not be considered to be a justification for exemption from any of the requirements for the internal model set out in Articles 120 to 125

*Article 126*

**What are external models?**

Some commonly used examples are:

- Catastrophe risk models (underwriting risk)
- Economic variability models (ESGs);
- Credit models; and
- Reserving

**Why use external models?**

- Suitability & reliability
- Legacy, conversions and acquisitions.
2. Approval process & EIOPA guidelines

Approval process

1. Cover letter requesting approval
2. Confirmation that all clarifications and documentation have been provided
3. Application approval from the administrative or management body
4. Results of the latest ORSA and details of business and risk strategies
5. Scope of application – full or partial model approval
6. Risk management process and risk profile
7. Self-assessment (of internal model for compliance with the six tests) including strengths and weaknesses of the model
8. Technical characteristics of the internal model
9. Use of external models and data
10. Model governance, systems and controls including documentation
11. Relevant organization charts
12. Up-to-date independent review/validation report
13. Change policy for the full/partial model and other model governance policies
14. Plan for future model improvement
15. Capital requirement, including an estimate of the SCR using the standard formula
EIOPA guidelines

- Consistency across national regulators
- Avoid losing momentum
- Upon adoption national regulators must make every effort to comply
- Expect to be effective by Jan 2014
- Do not require regulators to take supervisory action for non-compliance

Internal model pre application

- Pre application not a requirement of Solvency II
- Pressure from industry to increase convergence of supervisory practices
- Covers areas regulators should review
  - Use test
  - Assumption setting
  - Use of expert judgment
  - Calibration
  - Validation
  - Documentation

3. Implications - contrasting EU & US
**Valuation models**

NAIC has permitted the use of models in the determination of certain reserving and capital calculations. The rules governing the use of these models are fairly prescriptive and regulators set the parameters and time horizons used. As a result these models are not subject to regulatory approval.

There is no strict definition under Solvency II of an "internal model". It refers to the collection of processes, systems and calculations that together quantify and rank the risks faced by the insurer. Solvency II encourages firms to use internal models in the belief that it will lead to a better alignment between the company’s capital requirements and the company’s risk management policies.

**Implications**

- Scope to better align the capital requirement with the insurer’s risk profile.
- The potential for reduced capital requirements.
- Greater reliance on complex models and the need for model risk management.
- Increased complexity and costs.
- Increased regulatory resources necessary to adequately examine and understand internal modeling.
- The potential for reduced objectivity of regulatory intervention levels.
- Reduced comparability across insurers.

**Capital levels**

US RBC is a basis for assessing the minimum regulatory capital. RBC allows regulators to identify potentially "weakly" capitalized companies.

Solvency II requires that companies calculate the SCR and MCR. SCR is a prescribed regulatory hurdle intended to allow timely supervisory intervention.

**Implications**

- Differing regulatory intervention levels.
- US with EU parent may need to hold additional regulatory capital somewhere in the group.
- Applying the Solvency II SCR may not be straightforward.
- Implementation costs
- Group capital requirements
**Total balance sheets**

Under US statutory accounting, the balance sheet is composed of statutory reserves and additional miscellaneous liabilities (such as an asset valuation reserve) and equity composed of required capital and free surplus.

Under Solvency II, liabilities are composed of technical provisions and an explicit risk margin. Equity is composed of the capital requirements and free surplus.

**Implications**

- Relative impact depends on conservatism, point in economic cycle and other assumptions.
- Opportunity for regulatory arbitrage.
- Revised investment strategies, allocations and mandates.
- Incentives to find ways of mitigating capital needs.

**Liability valuations**

The IAIS ICPs require an economic valuation. Interpretation of this requirement varies, and the US appears likely to follow existing non-market-consistent approaches to determining the liabilities.

Under Solvency II, liabilities are determined using a market-consistent approach although the long term guarantee package moves elements of the approach away from pure market-consistency.

**Implications**

- Value under current conditions rather than ability to fund long term obligations.
- Increased volatility – good and bad.
- Viable products look uneconomic.
- Inappropriate impact on public perception of strength of the industry.
- Reduced product offerings and moving risk to policyholders.
- Procyclicality.
**Equivalence**

**US**

SMI has clear objectives to enhance US supervision but has explicitly determined not to move US regulation towards Solvency II to achieve equivalence.

The treatment of EU companies’ insurance subsidiaries in other territories depends on whether that regime is determined to be equivalent or not. If the regime is equivalent, then local regulatory results may be used; otherwise the Solvency II requirements apply.

**EU**

**Implications**

- Without equivalence US Subsidiaries of EU groups will need to determine capital on a Solvency II basis.
- US parents of EU insurance companies/groups face the potential need to restructure and capitalize the EU insurance group to Solvency II levels.
- US companies without EU affiliation will be largely unaffected by a lack of US equivalence.

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**Thank you...**

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Solvency II
Internal Models

Henny Verheugen (Principal) – Milliman Amsterdam
Brian Paton (Director) – PWC Chicago

Agenda
- Solvency II
  - Goals of Solvency II and relation with internal models
  - What is an internal model?
  - Why use an internal model?
- Regulatory requirements
  - Documentation standards
  - Validation standards
  - Use test
Agenda (continued)

- Regulatory requirements
  - Calibration & statistical quality
  - P&L attribution
  - Governance
  - External models

- Approval process & EIOPA guidelines

- Implications - contrasting EU & US
  - Valuation models
  - Capital levels
  - Total balance sheets
  - Liability valuation
  - Equivalence

Solvency II - Broad objectives

- **Enhance protection** of policyholders and beneficiaries ➔ **Sufficient own funds**
- **Increase awareness of key risks** through measurement and assessment ➔ **ORSA and SCR**
- **Incentivise** more sophisticated risk management approaches ➔ **Risk based solvency, early warning and better pricing**

Obtain detailed insight into the key risks and the development of these risks over time (forward-looking and in retrospective).
What is an internal model?

EIOPA does not give a formal definition of what an internal model is.

**Article 112 General provisions for the approval of full and partial internal models**

Member States shall ensure that insurance or reinsurance undertakings may calculate the Solvency Capital Requirement using a full or partial internal model as approved by the supervisory authorities.

**IAIS:**

Risk management system developed by an insurer to analyze the overall risk position, to quantify and rank risks and to determine the economic capital required to meet those risks

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**Principle based/Rule based**

- The majority of the Solvency II regulations are principle based

- Important exception: the calculation of the SCR is **rule based**

**Strict requirements regarding:**

- Risk classification
- Risk measurement
- Aggregation via correlation matrices

**Deviations** are considered to be an internal model.
Drawbacks of the standard formula

- Relatively simplistic scenario-based approach
- Nonlinear and interdependent impacts are not adequately covered
- The standard formula does not capture “fat tails”
- Group structures are not captured adequately

Why use an internal model?

Primarily dependent on:
- Scale
- Complexity

The standard model is developed and calibrated for the majority of the business.

Standard model = “One size, fits all in a simple way”
Why use an internal model?

- Better integration of the models with the risk management organisation (a.o. ORSA, P&L attribution, Use test, Governance, Validation) improves the quality of the entire organisation

- Better insight into risks and their behaviour

- Better risk monitoring

- Lower SCR? Not necessarily

Effect on pricing and technical provisions

- The SCR is an important input for the determination of the risk margin.

- Direct impact on pricing and the technical provisions (TP).

![Diagram showing SCR, MCR, and Technical provisions]

Application process:
Some supervisors consider TP to be part of the internal model and therefore part of the application process.
Agenda

- Solvency II
  - What is an internal model?
  - Why use an internal model?
- Regulatory requirements
  - Documentation standards
  - Validation standards
  - Use test

Use of Internal Models

Regulatory approval required for the use of an internal model for the calculation of the SCR
Requirements are embedded in the Solvency II legislation.

1. Documentation standards
2. Validation standards
3. Use test
4. Statistical quality
5. Calibration standards
6. Statement of profit and loss
7. Governance
8. External models and data
Documentation

The documentation of the model is the main material the supervisor will assess during the application process.

It takes a lot of time and effort to produce and maintain the information, but it is necessary to document all details and more importantly, the decisions made during the development process.

Documentation - requirements

- must be clear, complete, unambiguous, detailed and suitable enough to allow third parties to replicate the internal model. Outputs of the internal model should be reproducible.

The third party can make judgments about the assumptions made as well as the model structure and how it works.

May be requested to use benchmark data and to report the results.
Documentation - requirements

- It shall indicate any circumstances under which the internal model does not work effectively (weaknesses):
  - Uncertainties of assumptions
  - Incomplete portfolios (non-modelled business)
  - Non-modelled risks
  - Simplifications and/or inconsistencies in calculations
  - Insufficiencies in IT-systems, governance and related controls

- The documentation shall include evidence that all levels of management of the undertaking understand the relevant aspects of the internal model.

Documentation (possible structure)

Generic principles

Theory and methodology

Model documentation

Contingency, Security and Business Continuity

Governance and process documentation

Architecture and data flow information

Validation and test results of model
Software/Model Development phases support the documentation standards

<table>
<thead>
<tr>
<th>Phases</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idea</td>
<td>model description</td>
</tr>
<tr>
<td>Analysis</td>
<td>requirements</td>
</tr>
<tr>
<td>Design</td>
<td>design document</td>
</tr>
<tr>
<td>Build</td>
<td>model documentation</td>
</tr>
<tr>
<td>Testing</td>
<td>test documentation</td>
</tr>
<tr>
<td>Implementation</td>
<td>user manual and training</td>
</tr>
<tr>
<td>Post implementation</td>
<td>evaluation and review</td>
</tr>
</tbody>
</table>

Validation

- Validation
  - demonstrates that there is a regular cycle of model validation that includes monitoring performance, appropriateness of standards specification and testing results against experience.

- Tools and processes to gain confidence over the results, design, workings and processes of the internal model

- 2 points to focus on
  1. Validation policy
  2. “Tools” used by validators
Scope of validation policy

- Includes at least the validation of:
  - Documentation of data, model, assumptions and methodology
  - Use of expert judgment and application of management actions
  - User acceptance testing of models
  - Performance and integration of IT systems
  - Model governance structure (sign off by management) and processes
  - Usage of the models and results in business processes and decision making

Results used in validation process

- Back testing results (prognosis of results)
- Stress testing using extreme scenarios
- Profit and loss attribution

Validation Policy

- Company’s responsibility to validate frequently – more often for more volatile risks, but at least annually
- Conducted by an experienced and independent validator (internal or external)
- A validation policy for each firm is required to tailor validation processes to the company’s profile

Follow the model life cycle

Limitations of policy

Documented policy

Independence

Scope of validation

Tools used

Frequency of validation

Governance of results
Validators

- **Must use**
  - Stress & Scenario Testing
  - Sensitivity testing

  - Tests: primarily on balance sheet items and impact on SCR
    - # of scenarios
    - data points/grouping of data
    - parameters

  - Sensitivity of results
  - Robustness and stability of internal model

**Technical provisions**

**Surplus SCR**

**Assets**

- **Must use**
  - Tests against experience (TAE)
  - P&L attribution

  - TAE; focus on SCR and development during year
  - P&L attribution; focus on Own funds (assets and liabilities) and development during year

  - High frequency and volatile risks
  - Trend risks
  - Breakdown of the income statement
  - Completeness of risks
Validators

- **May use**
  - Benchmarking and hypothetical portfolios
  - Qualitative review (internal audit and other review processes)
  - Analysis of change of SCR over time
    Challenging: development of the balance sheet and of the risk factors

Validation incorporated in model development

<table>
<thead>
<tr>
<th>Phases</th>
<th>Product</th>
<th>Model fit for purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Idea</td>
<td>&gt; description</td>
<td>Regulatory need</td>
</tr>
<tr>
<td>- Analysis</td>
<td>&gt; requirements</td>
<td>Appropriateness of methodology, data and assumptions</td>
</tr>
<tr>
<td>- Design</td>
<td>&gt; design document</td>
<td>“Best practice”</td>
</tr>
<tr>
<td>- Build</td>
<td>&gt; model documentation</td>
<td>Design, model and test documentation</td>
</tr>
<tr>
<td>- Testing</td>
<td>&gt; test documentation</td>
<td>Availability of user manuals</td>
</tr>
<tr>
<td>- Implementation</td>
<td>&gt; user manual and training</td>
<td>Have processes and governance in place</td>
</tr>
<tr>
<td>- Post implementation</td>
<td>&gt; evaluation and review</td>
<td>Back testing of results</td>
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<tr>
<td></td>
<td></td>
<td>Correct model use</td>
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<tr>
<td></td>
<td></td>
<td>Monitor model performance</td>
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</tbody>
</table>
Use test

- Prove that the internally developed model is used in strategic and tactical decision making.

Risk management framework

Internal model

Measurement

Use test application

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