Understanding the dynamics of an Internal Model using Internal Model Output (IMO)

Dimitris Papachristou
Bank of England - PRA

17 January 2018

Agenda

- What is IMO?
- Purpose and Objectives of IMO Analyses
- Limitations and Quality of Data
- Key Messages
Why IMO?

- PRA statutory objectives
  - Safety and Soundness of Firms
  - Protection of Policyholders
  - Secondary objective: effective competition
- Internal Models (IMs) are central to capital setting and their role has been elevated under SII
- Continuous credibility of Internal Models is important
- Constructive discussion of the IMO analysis with Firms has led into beneficial changes
- PRA appreciates the effort that Firms put in preparing the IMO submission

What is Internal Model Output (IMO)

- 3 templates for life, general insurer and both (available on Bank of England web)
- reserve risk, premium risk, cat risk, market risk, correlations
- mean, st.dev., 80th, 90th, 95th, max, min
- one year & ultimate line of business gross & net
- Average 2MB per firm
- approved full & partial internal models
- pre-application models depending on readiness
- groups & solos
- 20 firms
- 95 syndicates
- 2013, 2015
- annual data
- same deadlines as NST and QRT
- 5 Years
Objectives of IMO Analysis

What are the key risk drivers of capital?
- Lines of business
- Correlations
- Impact of reinsurance

Has the IM parameterisation changed over time?
- Expected profit
- Volatilities
- Correlations

Are the capital requirements of firms consistent with their risks?

Identifying key risk drivers
- Focus our reviews on most material risks
- Understand the dynamics of the model
- Carry out quick sensitivity analysis on many parameters
- Identify common risk drivers in the market

Monitoring changes in the model
- Ensuring that the parameterisation continues to reflect risk
- Changes in parameters reflect changes in market conditions

Checking for consistency
- Avoid herding, but ensure that firms with similar risk do not have very dissimilar capital requirements

Individual Firms and Syndicates

Market
Why we ask for this information? specifics

- Gross and Net of Reinsurance
  - Gross for parameter comparisons
  - Net for SCR impact
- Discounted and Undiscounted
  - Undiscounted for parameter comparisons
  - Discounted for SCR impact
- Own Lines and SII Classes
  - SII classes for comparisons
  - Own lines for better understanding of the risk

- One Year and Ultimate
  - FALs for Lloyd’s
  - Methodology
- Linear and Rank correlations
  - Rank for removing the impact of marginal distributions
  - Linear for impact on SCR and sensitivity analysis
- Market risk Information
  - Firms adjust ESG parameters

Identifying and Understanding Key Risk Drivers
Most Material Lines and Correlations

- Assume capital requirement is $C = \sqrt{C_i^2 + 2 \sum_j \rho_{ij} C_i C_j}$, where $C_i = 99.5\text{th percentile} - \text{mean for the } i\text{-th risk}$

- Calculate $\frac{\partial C}{\partial C_i}$ and $\frac{\partial C}{\partial \rho_{ij}}$ (leads to neat and intuitive results)

Impact of Reinsurance on capital charges

- Understand a Firm’s risk mitigation methods and assess impact
  - Monitor changes over time
  - Check against SII reinsurance data
Key catastrophe exposures

- Improve preparedness in the case of a catastrophic event
- Exposure of a Firm to different perils
- Exposure of Firms to a certain peril

Identifying key risk drivers - summary

- Identify key capital drivers
- Understand impact of reinsurance
- Identify exposures to certain events
Monitoring IM Changes over time

Reasons for changes in SCR

Exposure

- Changes in
  - volume of business
  - mix of business
  - underlying risk
  - reinsurance
  - and many other reasons…

IM Methodology and Parameters

- Changes in
  - volatility parameters
  - correlations
  - assumed profitability
  - methodology
  - and many other reasons…

- We need to distinguish changes in SCR due to genuine changes in exposure and changes in assumptions and parameters.
- Easier said than done even by Firms, for many practical reasons.
SCR Analysis of Change

Parameters - Exposure - calculations - output - SCR

IM

IMO

IMO: summary of IM output + some exposure information

Parameters - Exposure

Analysis of SCR change based on IMO

- Ultimate SCR has increased
- Reserving risk has increased, but
  - This is mainly due to increases in volume
  - The assumed reserving risk volatility has decreased
  - Assumed correlations between reserving classes have increased
  - Simulation error?
Heat Map and Areas for further Investigation

- Net reserves, net premiums and SCR have generally increased.
- Reserving risk parameters have been reduced. We are investigating.
- Certain areas have been flagged up for individual Firms

<table>
<thead>
<tr>
<th>Firm</th>
<th>Reserving Risk</th>
<th>Premium Risk</th>
<th>Risk Types</th>
<th>Exposure</th>
<th>SCR change</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-15</td>
<td>5</td>
<td>0</td>
<td>-1</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>7</td>
<td>-16</td>
<td>7</td>
<td>-1</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>C</td>
<td>-11</td>
<td>5</td>
<td>1</td>
<td>-25</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>38</td>
</tr>
<tr>
<td>E</td>
<td>1</td>
<td>-1</td>
<td>3</td>
<td>0</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>F</td>
<td>-3</td>
<td>-2</td>
<td>24</td>
<td>-2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>G</td>
<td>-24</td>
<td>1</td>
<td>0</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>H</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>I</td>
<td>-13</td>
<td>1</td>
<td>-3</td>
<td>-1</td>
<td>-7</td>
<td>-14</td>
</tr>
<tr>
<td>J</td>
<td>-26</td>
<td>-1</td>
<td>-23</td>
<td>-1</td>
<td>0</td>
<td>-2</td>
</tr>
<tr>
<td>K</td>
<td>-18</td>
<td>0</td>
<td>-12</td>
<td>0</td>
<td>1</td>
<td>47</td>
</tr>
<tr>
<td>L</td>
<td>-27</td>
<td>0</td>
<td>-16</td>
<td>0</td>
<td>-3</td>
<td>-25</td>
</tr>
<tr>
<td>M</td>
<td>-38</td>
<td>0</td>
<td>13</td>
<td>0</td>
<td>-3</td>
<td>-14</td>
</tr>
</tbody>
</table>

Analysis of Change Summary

IMO tools can carry out an approximate analysis of change and distinguish between changes in exposure and changes in IM assumptions.

This enables us to investigate changes in assumptions in IM and helps us identify possible capital drift.

We flagged up certain areas of individual firms for further investigation.

Drift is something which can be better identified over a longer than one year period. PRA will monitor changes over the years.

Warning

- IMO analysis is approximate. It does not cover all risks and depends on data with limitations and whose quality can not be checked thoroughly.
- In particular, SII Class data are not used by Firms and therefore these data may not be subject to sufficient checking. We have seen evidence of this.
- IMO data do not capture changes in the underlying risk.
- Analysis of change is distorted by many factors and results could be due to artefacts of the data and method.
- IMO analysis can flag up issues, but it can not capture all potential issues and capital drift.
- Possible false warnings and undetected positive warnings.
Checking for consistency

- Avoid herding, but ensure that Firms are being treated fairly

Allow for differences in
- risks
- size
- copulae
- other
Consistency summary

Every Firm is different, methodology has been reviewed

Herding risk

Consistency and fairness

Limitations and Quality of Data
Some Limitations

- All methods include material approximations
- Approximations often assume an underlying multivariate normal; wherever relevant allowance should be made for
  - skewness and
  - stronger tail copulae
- IMO does not include information on
  - reinsurance programme
  - expense details
  - underlying drivers, such as inflation model, and
  - many other elements of the Internal Model
- SII granularity may not be appropriate
  - Move to Firm’s own lines granularity

Quality of Data

- In 2018 (YE17 IMO) the IMO template will remain unchanged
- The quality of data has improved over time, but there is scope for further improvement
  - Quality of data varies by Firm
- Structure of IMO template does not necessarily correspond to the structure of the model
- Given the elevated role of IMO in monitoring the evolution of the IMs, it is important that the quality of IMO data improves
Utilising other available information

- Utilising information from different sources will result in richer analysis and more informed decisions

- Need for improving the quality of data

Key Messages

- IMO is an important element in assessing the appropriateness of IMs and their continuous credibility
- The effort that Firms put into preparing IMO is appreciated and worthwhile
- IMO is one of the different ways of assessing/monitoring the evolution of the IMs
- PRA encourages sharing of the IMO analysis with Firms and constructive feedback
- Parameter weakening will be followed up and challenged by the PRA