NON-LIFE UNDERWRITING RISK COMPARATIVE STUDY IN INTERNAL MODELS

4 January 2024

European Insurance and
Occupational Pensions Authority

CONTENTS

1. EXECUTIVE SUMMARY

EIOPA conducts comparative studies to evaluate the performance of different aspects of the insurance and pension sectors in the European Economic Area (EEA). Comparative studies focus on specific areas of interest such as the calculation of specific Solvency Capital Requirements (SCR) in internal models.

Non-life underwriting risk contributes significantly to the SCR of insurance undertakings and is of material importance for the majority of internal model undertakings (IM users). Consequently, the EIOPA Board of Supervisors decided to perform a European-wide comparative study on non-life underwriting risk in internal models (NLCS) at the beginning of 2020 presenting the second study of its kind[1]. The exercise was conducted by a joint project group of members from National Competent Authorities (NCAs) and EIOPA (from now on "the project group").

As the study remains independent from the underlying methodologies employed by the internal models, it has the capacity to investigate and compare the modelled risk profile as fairly as possible. This enables comprehensive analysis of the business development, facilitating the identification of peer group behaviour and dominant factors through a detailed risk profile decomposition.

This report summarises the key findings from the NLCS, which covers the first half decade of non-life underwriting risk internal models from year-end 2016 to 2020[2]. Furthermore, it provides an insight into the supervisory initiatives being taken following the conclusions of this study. The main results are summarized below.

INDIVIDUAL FEEDBACK SESSIONS

The NLCS is a joint effort of the European supervisory community and leverages on the intimate knowledge of the internal models by local supervisory teams as well as on the transversal coverage of a European-wide comparative study.

In practice, the project group used peer group analysis to triangulate and sense check individual undertakings. The project group provided participating undertakings with tailored feedback packages going beyond the global view outlined in this report. Individual feedback sessions highlighted and explored undertakings' relative positioning, which enabled constructive discussions with and challenge of individual results against European wide peer group samples.

Discussions initiated during individual feedback sessions will continue throughout the national supervision of both solo undertakings and groups. Undertakings identified as outliers have been notified and local NCAs are following up.

[1] A first edition was conducted in 2018, however its report was not public.

[2] The analysis on diversification was performed with data from m2018 to 2020 and was aligned with the EIOPA Diversification PG.

CAPITAL INTENSITY

Undertakings with similar economic P&L distributions (and profit levels) can operate currently on significantly different capital levels and intensities[3] within non-life underwriting risk. Therefore, the NLCS examined the dispersion for individual undertakings and respective peer groups as well as its variation over time in order to identify potential root causes.

Results did in general not indicate model drift towards lower or higher capital intensities for the high-level granularities, i.e. total non-life risk (Total), premium risk (PR), reserve risk (RR) and catastrophe risk (CAT). For several participants, however, the project group observed outlier behaviour compared to the entire sample or other relevant peer groups.

The analysis of capital intensities helped to distinguish relevant issues from inconsequential observations and link analysis on lower levels (drilling down) to high-level observations.

RISK MEASURE FOR PREMIUM RISK

One of the main findings of this study and main driver for outlier behaviour on the lower end of capital intensity was linked to the use of non-centered risk measures[4] and particularly its treatment of profits in future business subject to premium risk (cf. section 4 & 6.2). Due to its relevance additional analysis are being conducted within the European supervisory community.

STANDARD FORMULA COMPARISON

This analysis has been established over the course of two NLCS studies and provides simple benchmarking metrics across granularities. The analysis is mainly based on the decomposition of P&L distributions against the standard formula equivalents on Solvency II line of business (S2LoB[5]) and internal line of business (IntLoB[6]) granularity level.

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[3] Capital intensity is defined as SCR over exposure such as Premium or Best Estimate Reserve, cf. section 4.

[4] Internal models have flexibility in the way they model risk in order to reflect their risk profile appropriately. Since Solvency II is a principle-based framework undertakings with internal models benefit from some degree of modelling freedom (I.e. Art. 122 (1) Directive 2009/138/EC) as long as they can produce equivalent protection levels compared to article 101 (3) Directive 2009/138/EC. Deviations are subject to supervisory approval and need to be explored, discussed and disclosed in the SFCR and ORSA. Conceptually internal models can produce higher or lower results than the standard formula.

For the future business subject to premium risk, the expected results are not incorporated in the best estimate, and the NLCS identified two different approaches (risk measures):

- No consideration of the expected results (**centered approach**);
- Consideration of the expected results (**non-centered approach**) as a risk mitigant which increases (in case of expected losses)/reduces (in case of expected profits) the initial SCR calculation.

[5] defined by the standard formula lines of business

[6] defined by the internal view of risk within the internal model

The analysis suggests that for most premium risk and reserve risk S2LoBs the internal model undertakings operate on a more favourable capital intensity level, volatility and distribution type compared to the standard formula. Furthermore, in a number of cases, a high dispersion of results was observed.

INFLATION

In 2020, inflation levels in the EEA had been stable around and below the ECB's two percent target for about two decades. However, the Russian invasion of Ukraine and global supply chain bottlenecks changed this assessment, making inflation a priority topic on the supervisory agenda. The project group used available data on the time value of money to explore potential impacts through dedicated stresses.

Inflation has a direct and immediate impact on the level and evolution of paid claims and claims reserves. Alongside the adjustments made on the economic balance sheet, accounting for this year's inflation and any modifications in long-term assumptions (e.g., RFR changes), internal models must also account for the amplified uncertainty surrounding future inflation levels. In many cases it is necessary to understand how inflation has been incorporated in the modelling of paid claims and claims reserves in order to understand how inflation impacts the capital requirements.

The majority of IM users have implicitly integrated inflation into their non-life underwriting risk. While this approach tends to work adequately when past inflation data can reasonably predict future inflation, it becomes less reliable when inflation levels undergo rapid and significant changes as in the current environment.

During individual feedback sessions, the project group discovered that for year-end 2022, most undertakings anticipated that only up to half a year of inflation will be accounted for due to the timing of normal claims handling processes, and even less for reinsurers. Consequently, undertakings relying on implicit modelling depend heavily on ad hoc expert judgment to address the current changes in inflation environment.

Undertakings which model inflation explicitly have a more explicit means in the integration of inflation risk, however, it is key that their economic assumptions are updated consistently between market risks and underwriting risks. Discussions with undertakings showed that the economic scenario generators updating cycle was not necessarily keeping pace with emerging market necessities.

Analysis of the NLCS indicates, in addition, that one of the most severe scenario results is the transition to a plateau of higher level of inflation due to a compounding inflation effect and not per se from a temporary inflation spike.

Undertakings should evaluate whether they currently operate in a period of heightened uncertainty regarding inflation's development. This could potentially lead to an increase in the Solvency Capital Requirement beyond the proportional rise driven by exposure increases due to claims, reserves and premium.

DIVERSIFICATION

The analysis revealed a significant variation in observed diversification benefits between premium risk and reserve risk across undertakings, demonstrating generally higher diversification benefits when compared to the levels prescribed in the standard formula.

Additionally, within premium risk, the diversification between lines of business was also found to be higher compared to the standard formula.

However, it is worth noting that diversification benefits remained consistent over time in most instances, suggesting the absence of model drift concerning diversification over a 3-year period from 2018 to 2020.

DRILLING DOWN

The drill-down analysis of this study provides deeper insights by examining granular details, leading to a comprehensive understanding. In particular, the study identified key influencing factors for the level and development of the Solvency Capital Requirement of non-life underwriting risk on different granularities and portfolio specific peer groups (e.g. business mix FIRE and top-down as well as bottom-up analysis of credit and suretyship), which are at supervisory disposal of NCAs.

Within the individual feedback sessions, the project group and NCAs discussed outlier behaviour at S2LoB level and NCAs are following up where developments are not linkable and explainable by risk profile of portfolios at IntLoB level. In some instances (e.g. motor lines of business) limited differentiation opportunities existed due to low granularity and there seems to be space for improvement on meaningful granularities for a number of undertakings.

CREDIT & SURETYSHIP

The NLCS project group identified the need for individual analysis on credit and suretyship insurance (C&S) due to its complex and unique risk characteristics. Therefore, a comprehensive dedicated data request was developed to support targeted C&S analysis by a group of specialized experts. The analysis performed share commonalities (e.g. in terms of data and indicators) with the NLCS but has also its own areas of focus to take into account the specificities of C&S. Analyses were performed to assure that capital requirements are appropriate for C&S and consistent with other non-life lines of business and other trade finance actors (e.g. factoring business).

The modelling approaches for premium, reserve, and catastrophe risk for C&S are different amongst undertakings. For the majority of direct insurers, differences among capital requirements are limited and were explained by their risk profile.

Capital intensity for catastrophe risk is influenced by the reduction in credit limits. Trade credit insurers have reduced cover during recessions and times of crisis in the past, thereby having fewer underwriting losses than would otherwise have been the case. As SCR's are based on historical data, they reflect this behavioral response and are lower in the event of reductions in cover. Therefore, if credit insurers were not able to reduce cover in the event of a pending crisis, they might incur losses that they could find difficult to absorb.

IM QRT READINESS

The new uniform IM QRTs (from YE2023 onwards) introduce a new common reporting approach for EEA internal models. In fact, the NLCS was in part designed to test the undertakings' ability to comply with the IM QRTS data requirements with respect to non-life underwriting risk. This approach allows supervisors with participants in the NLCS to start with up to a 5-year time series as reference point for the new IM QRT reporting.

The analyses indicate that most undertakings are well prepared for the introduction of the IM QRTs, with the exception of some participants. For these undertakings further activities are necessary to address identified areas for necessary improvements before YE2023 with respect to non-life underwriting risk.

SUPERVISORY FOLLOW-UP AND OUTLOOK

The NLCS is not a stand-alone exercise but one important element in the EEA-supervisory toolkit for monitoring the on-going appropriateness of internal models covering non-life underwriting risk.

Effective supervisory follow-up is essential for ensuring the stability and solvency of non-life insurance undertakings, protecting policyholders, and maintaining the overall health of the insurance market. The analysis, discussion and agreed follow-up of the study contribute to the supervisory review process (SRP) of NCAs at local and group level.

Participating NCAs are provided with tailored feedback packages going beyond the global view outlined in this report enabling them to discuss and challenge the participating undertakings. In some instances, the NLCS results also feed into the respective regular validation processes and specific validation exercises performed by undertakings. These activities already led to model changes. This is also expected to occur in the future and EIOPA will follow up on NCAs' activities. Specific highlights of follow up from the NLCS activities include the following:

- **Data & IM QRT readiness:** The general follow-up includes qualitative and quantitative benchmarking, as well as further activities for improvements of the IM QRT readiness before YE2023. The NLCS triggered a number of on-site inspections and other collaborative activities on national level. The reasons ranged from findings with regards to data availability, aspects of risk management all the way to lack of data quality. Data of heterogeneous quality has been provided for C&S.
- **Negative risk capital:** The NLCS linked the observation of negative risk capital to findings with regards to the use of non-centered risk measures. NCAs follow up on national level and on-site inspections have been triggered linked to this topic.
- **Low standard formula benchmarking:** The project group identified a number of outlier behaviours for individual undertakings and groups. Inflation modelling: Finally, the analysis laid out supports the supervisory conversations and SRP of NCAs for year end 2022 submission going forward. For some of the undertakings it would be useful to start a conversation about their

readiness to sustain medium term stresses of increased netted stresses of inflation and risk-free rate. Most undertakings agreed that inflation as a topic will be discussed in ORSAs and or in IM reparameterizations.

Specific follow-up for each of the described analyses is available at the end of each chapter.

EIOPA will support NCAs' on the follow-up and monitor the development of the findings. Additionally, the outcome of the NLCS is used in other supervisory processes, especially the assessment of model changes and initial applications for solo and for group models.

Furthermore, the NCAs' feedback on the setup of the study itself and potential improvements for future studies were collected.

2. OBJECTIVES OF THE STUDY

SETUP

EIOPA conducts comparative studies to evaluate the performance of different aspects of the insurance and pension sectors in the EEA. Comparative studies typically focus on specific areas of interest such as the calculation of specific SCR in internal models.

Non-life underwriting risk contributes significantly to the SCR of insurance undertakings and is of material importance for the majority of internal model undertakings. Consequently, the EIOPA Board of Supervisors decided at the beginning of 2020 to perform a European-wide comparative study on non-life underwriting risk in internal models (NLCS) as the second study of its kind. The exercise was conducted by a joint project group of members from NCAs and EIOPA.

This NLCS edition is the second comparative study of its kind and large parts of the exercise are based on the design, follow-up and lessons learned of the first edition of 2018. Furthermore, part of the NLCS survey was developed jointly with the project group on diversification (DivPG) so that the collected information could be shared between the comparative studies. This approach lightens the burden for the insurance and reinsurance industry by avoiding double reporting of the same information.

AMBITION AND ANALYSIS FOCUS

The study aims at a fair evaluation of non-life underwriting risk amongst internal models at a European level and their development over a five-year time horizon. Moreover, the analysis of this study is designed in such a way that the readiness of participants' internal models for the new internal model quantitative reporting templates (IM QRTs) can be tested.

Key to both endeavours is the decomposition of the non-life underwriting risk profile. The study therefore explores the relative positioning in terms of capital positions on different granularities in order to identify dominating factors based on a number of metrics following the Solvency II framework as well as the internal models' definition of risk.

The employed comparison framework is independent from the underlying methodologies of internal models to enable the exploration of modelled risk profile and actual business development.

Given the complexities of the overall non-life underwriting risk modelling process and the different risk profiles of undertakings, the collected data facilitates a review of the overall dispersion of model outcomes as well as analyses of individual model components. In order to monitor, understand and

explain the overall behaviour of non-life underwriting risk the analysis furthermore drills down specific portfolios or focus analysis in more deeply.

The chosen approach enables internal model comparisons across different infrastructures and modelling approaches in order to identify and analyse peer group behaviour.

With respect to granularities, the study collected the overall non-life underwriting risk and its decomposition across a number of sub-risk granularities within premium risk, reserve risk and catastrophe risk.

CONCLUSIVENESS

The study is designed to support the supervision of internal models and fosters the convergence of supervisory practices and approaches. Thanks to its output focus the study introduces metrics independent from the local implementations within internal models and leverages on the close collaboration of the European supervisory community and their expertise.

The study contributes to the SRP at local and group level. In practice, the NLCS and its conclusions have already been used by NCAs and supervisory colleges.

3. PROCESS, SCOPE AND DATA

3.1. PROCESS

The design of the study is based on best practices from NCAs and includes informal feedback received through stakeholder outreach as well as findings and lessons learned from an initial NLCS edition carried out on year-end data from 2016 and 2017. The sample of the study was selected to guarantee a high coverage of insurers and reinsurers using an approved internal model for non-life underwriting risk.

A project group operationalised the objectives, by deriving a concrete data request for undertakings. The initial data request was collected by the responsible NCAs ("participating NCAs") local supervisory team and included first checks on consistency with regards to local reporting.

As part of this work the project group presented and discussed an initial data request in the format of a stakeholder event with the industry. Participants were able to share their comments during and after the stakeholder event. The informal feedback was considered within the improvements made for the final data request.

The project group processed the answers from the undertakings and performed thorough data quality and sense checks, with the aim of ensuring the reliability of the undertakings representation and the study's results. This step included feedback loops with undertakings and resubmissions when necessary. This also holds true for the analysis and its successive refinements. Furthermore, a reconciliation guaranteed consistency across surveys (survey A and survey B) within the NLCS and with the DivPG.

The project group developed dedicated tools to process the data submitted by undertakings and to carry out the analysis of the dedicated focus analyses. These tools mainly consist of programs written with the open-source language R. These programs allow the data from different participants to be aggregated into a single database. This database can then be filtered to extract specific information in the form of tables, or to plot it for further analysis and visual exploration. The tools were grouped into an analytics package which was regularly updated and shared with all project group members. The databases (DB A and DB B) were updated after receipt of resubmissions and, similarly to the analytics package, regularly shared with all the project group members.

The overall results were discussed in the supervisory community. In addition, dedicated feedback packages, especially focusing on the data quality and analysis highlights, were prepared and discussed with undertakings in individual feedback sessions, triggering follow-up if deemed

necessary. Where relevant, the results of these discussions were collated by the project group and fed into this report. The lessons learnt and feedback collected from all stakeholders may feed into the setup of the next edition or other comparative study.

Insights, methods and tools developed for analysis, comparison, data processing and data quality checks, as well as collaborative experience, will feed into the supervision of the ongoing appropriateness of internal models under the SRP and enhance the consistency of supervisory approaches including the introduction of IM QRTs.

The tools created, as well as the results of this comparative study, remain at disposal of the NCAs to enhance the consistency of supervisory approaches. Furthermore, key results were discussed with all relevant group supervisors and follow-up activities are envisaged.

3.2. SCOPE

RISKS

Internal models are historically rich in methodologies as well as modelling approaches. In particular, modules for non-life underwriting risk show low levels of standardisation compared to other risk categories. This study, therefore, mainly focuses on IM outputs/results to enable a technically sound framework independent from methodologies or modelling granularities. The resulting comparison metrics, which are independent from model structure and definitions, allow a fair comparison of the participants in the study. To achieve such metrics, the NLCS PG balanced its design with a standardised template while allowing extensively for deviation reporting in order to take into account variability factors (modelled risks, methodologies, etc.).

The requested quantitative data are mainly profit and loss distribution percentiles, the modelled SCR, as well as the exposure measures and some indicators for time-value of money (gross and net of reinsurance).

In line with the previous NLCS edition, the data request design was mainly based on the standard formula non-life underwriting risk modules and sub-modules. The quantitative information was collected at the following granularities:

- **Total non-life underwriting risk:** This is the top level at which non-life underwriting risk is aggregated and provides an overview of the resulting capital positions of the sample.
- **Total premium, reserve and catastrophe risk granularity:** These three granularities represent the three main sub-modules of the non-life underwriting risk within the Solvency II framework.

- **Solvency II line of business (S2LoB) granularity:** For comparative purposes the participants were asked to map their internal line of business to the most appropriate S2LoB (as defined in Annex II of the Delegated Acts).
- **Internal line of business (IntLoB) granularity:** This is the granularity at which the internal model users segment their business. This granularity is used for internal reporting, as well as for management of capital positions and are typically close to the parametrisation level.

With respect to premium risk and reserve risk the NLCS has collected additional qualitative and quantitative information for dedicated focus line of business (LoB) analysis for a better understanding of the modelled risk profile and identification of dominating factors. The dedicated focus LoBs are defined for the purpose of a dedicated drill-down analysis and align with the following Solvency II lines of business (S2LoB) definitions:

- **MTPL:** Motor vehicle third party liability insurance – S2LoB number 4 & 16 in the Delegated Acts
- **GTPL:** General liability insurance – S2LoB number 8 & 20 in the Delegated Acts
- **OtherM:** Other motor insurance – S2LoB number 5 & 17 in the Delegated Acts
- **FIRE:** FIRE and other damage to property insurance – S2LoB number 7 & 19 in the Delegated Acts
- **C&S:** Credit and suretyship insurance – S2LoB number 9 and 21 in the Delegated Acts

In addition, for a better understanding the risk profile of the undertakings, qualitative data on risk level, such as type of risk measure and risk emergence, as well as on IntLoB, such as risk location and dominant type of business, was requested to create meaningful peer groups.

Some deviations from the guidance were allowed. Internal model structures do not always match the standard formula risk definitions, therefore, some of the participating undertakings completed the surveys with out-of-model adjustments.

The subject of this study is the modelling of the non-life underwriting risk. Consequently, the conclusions of the study enable a comparison between participating undertakings of model outputs for some of these risks only, and not in terms of overall capital requirements. In particular, several effects which drive the overall SCR are not considered in the study, such as the dynamics of assets under changing financial market conditions or tax impacts.

The results of the study support and inform the supervision of internal models by fostering the convergence of supervisory approaches.

UNDERTAKINGS

The sample of the study guarantees a high coverage of insurers and reinsurers using an internal model for non-life underwriting risk.

In the NLCS 18 NCAs are involved for a total of 75 solo participants belonging to 31 insurance groups.

The NLCS sample covers a wide range of different business models amongst undertakings modelling non-life underwriting risk. Participants of the NLCS range from national champions to leading international (re)insurance groups covering a wide footprint of EEA and worldwide non-life exposure. The selection of the sample was based on national and European wide size and coverage criteria. The participating undertakings cover:

- 94% of premiums and
- 86% of the reserves

of the internal model users covering non-life underwriting risk in the European Economic Area.

3.3. DATA

ROLE OF DATA QUALITY

High data quality is a key aspect for a fair comparison of all participants. Therefore, significant effort has been made during all phases of the exercise in order to enhance the reporting tools as well as processes and ensure consistency among the reported data.

STAKEHOLDER INTERACTION

The European-wide comparative study supported participants with a number of possibilities to communicate and engage before, during and after the submission via the local NCAs.

- **Stakeholder engagement:** The project group organised multiple stakeholder events before and during the study in order to facilitate a positive interaction with affected stakeholders through all stages of the study.
- **Detailed LogFiles:** Both surveys (survey A and survey B) were accompanied by elaborate guidance on the filing similar to other European wide comparative studies.
- **Acceptance process:** The project group employed a staged acceptance protocol with split roles between undertakings, NCAs and project group members in order to share responsibilities.

- **Batch-wise submission:** The NLCS facilitated the option of early batchwise submissions for participating undertakings. Undertakings, which made use of this option, were able to detect errors early and therefore tended to perform better on the overall data quality.
- **Q&A process:** Participating undertakings were able to ask questions to the project group via their local supervisor. The project group answered more than 100 Q&As.
- **Individual feedback:** The project group organized individual feedback sessions with all participating groups to discuss their relative positioning and data quality of their submission as a last quality control step.
- **Validation checks:** To reach high consistency in the reported data, validations have been implemented in the survey files and resubmissions were facilitated throughout the entire data analysis process.

CONCLUSION AND FOLLOW-UP

Although high efforts have been made to ensure a high data quality, some data remained not fully compliant with the guidance. Therefore, some data had to be excluded from the analysis and outliers were discussed with the undertakings during the individual feedback sessions.

Moreover, although the coverage in terms of risk exposure of the participating undertakings in the study is very high, the sample had to be restricted to a lower number of data points for some parts of the analyses. In some cases, the number of data points is displayed on the charts to provide an understanding of the sample size for readers.

Only one undertaking had to be excluded completely from the sample due to low levels of data quality.

Taking into account the limitations described, the results of the study should not be considered as a calibration target.

4. METHODOLOGY

The project group has developed a European-wide methodology for the comparison of the non-life underwriting risk, which was used for all analysis of this report. In the following paragraphs some of the essential concepts are introduced.

CAPITAL INTENSITY

The study aims to identify key influencing factors for the level and development of the SCR of non-life underwriting risk on different granularities.

For a fair comparison it is, therefore, necessary to use a relative key risk indicator (KRI), which allows to analyse different magnitudes of SCR in a portfolio normalised way, by introducing a relative measure for comparison.

For the purpose of the NLCS this KRI shall be interpreted as amount of risk capital per unit of exposure. This implies for the KRI that, the higher the ratio, the higher the risk capital allocated per one unit of exposure. The KRI chosen for the NLCS was the capital intensity.

> The **capital intensity** corresponds to the SCR divided by an exposure measure.

The project group decided to use as exposure premiums and reserves as natural measures of exposure for non-life underwriting risk. Unless otherwise specified, the following exposure measures were used throughout the study for each risk category:

- **Premium risk**: Maximum between the earned premium (EP) and written premiums (WP)
- **Catastrophe risk**: Maximum between the earned premium (EP) and written premiums (WP)
- **Reserve risk**: Discounted best estimate reserves (BE)
- **Total non-life risk**: Sum of premium and reserve risk exposure $\rightarrow \max(EP, WP) + BE$

Capital intensities have been calculated at all levels of granularity. In graphs the unaltered capital intensity will be referred to as capital intensity or SCR to Exp depending on the context.

UPLIFT

The first edition of the NLCS observed a differing treatment of profits in internal models. Therefore, this study analyses the risk measure definition of internal models. For the purpose of comparison, the project group uses a concept called UpLift.

The **UpLift** is defined as the difference between the mean and the 99.5-percentile of the economic profit and loss distribution.

By its design the UpLift removes the effect of expected profits or losses as modelled in the internal model and is equivalent to the centered risk measure, which will be discussed in Chapter 6.2.

In graphs the capital intensity reliant on UpLift (only at the uncertainty of the results) is referred to as UpLift_Exp. It will be often compared to the SCR_Exp (capital intensity), which may also account for expected results.

BOXPLOT

In this study boxplots condense and visualize information on the distribution of various quantitative aspects of the European-wide sample of the study.

Boxplots are a typical and essential tool for supervisors, which help them to understand the likeliness of results in a given sample of peers. Furthermore, boxplots support supervisors in day-to-day supervision to understand peer groups and specific individual undertakings relative positioning (e.g. benchmarking of undertakings, markets and portfolios, development over time).

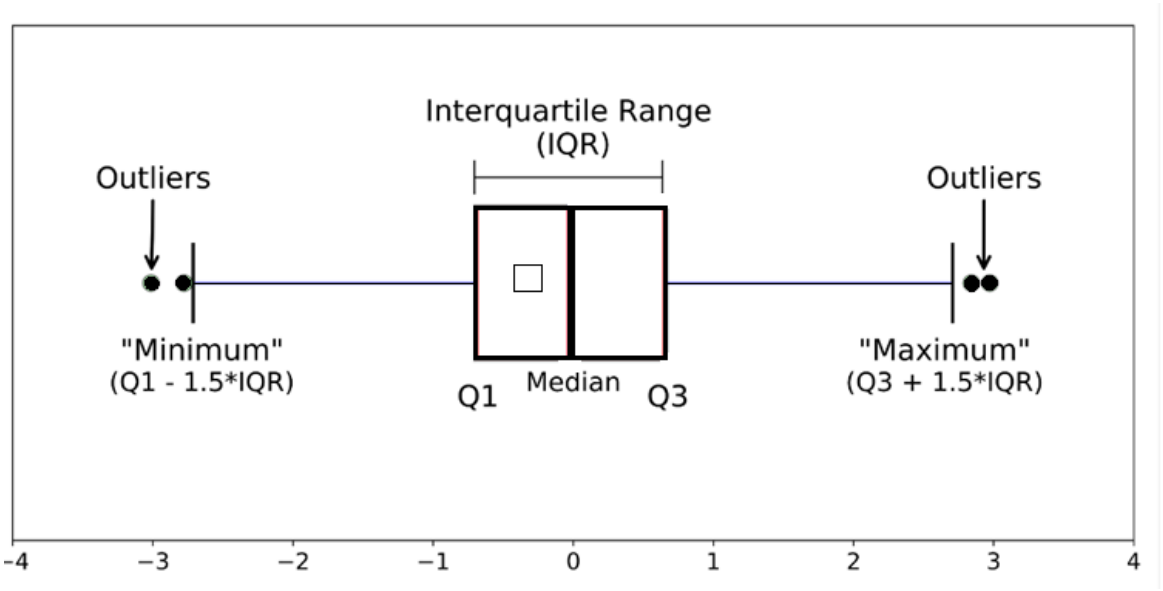

Figure 1 – Visualisation of standard box plot

The boxplots of this report summarise the distribution of a respective peer group sample summed into standardized representation by 6-numbers:

- **First quartile (Q1 / 25th percentile):** also known as the lower quartile is the point where a quarter of the observations are below this value.

- **Third quartile (Q3 / 75th percentile):** also known as the upper quartile, is the point where a quarter of the observations are above this value (or 75% of the observations are below the value)
- **Median (50th percentile):** the middle value in the data set (shown as a line)
- **Mean (Average):** This is the unweighted average of the sample (shown as little square)
- **Minimum (Q0 or 0th percentile):** the lowest data point in the data set (excluding any outliers).
- **Maximum (Q4 or 100th percentile):** the highest data point in the data set (excluding any outliers). The maximum is defined as Q3 plus the 1.5 times the inter quartile range.

The box represents the interquartile range (IQR) and is drawn from the first to the third quartile. The horizontal line through the box denotes the sample median. The whiskers go from the box to the lowest and the highest data points in the data set excluding any outliers, which are defined as outside of 1.5 IQR. Identified outlier points are identified as dots, if included in the graph.

5. CAPITAL INTENSITY OVERVIEW

This chapter provides an overview of the capital intensities observed for the NLCS sample. More specifically, this chapter focuses on the highest two granularities:

- **First level:** Total non-life underwriting risk
- **Second level:** Premium risk, reserve risk and catastrophe risk.

The reported values are net of reinsurance. Gross of reinsurance numbers, as well as the relationship with the net of reinsurance values have been explored, however, they are not included in this report.

Undertakings whose internal models covers only part of non-life underwriting risk, were asked to provide internal model and standard formula calculations. In the following sections, when referring to *Internal model and Standard formula (IM + SF)*, the displayed analysis refers to these global values, also including parts of the model calculated with the standard formula.

On the other hand, when referring to *Internal model only (IM Only)*, the analysis refers to pure internal model numbers, excluding any modules calculated with the standard formula.

Below the second level of granularity two further granularities are explored in this report, however they are not relevant for the analysis of this chapter:

- **Third level:** S2LoB granularities (5 focus S2LoBs per premium and reserve risk)
- **Fourth level:** IntLoB granularities (specific IntLoBs for each of the 5 focus S2LoBs)

5.1. TOTAL NON-LIFE UNDERWRITING RISK

INTERNAL MODEL AND STANDARD FORMULA (IM + SF)

Figure 2 displays the capital intensity for total non-life underwriting risk of the entire NLCS sample with varying portfolios and risk profiles of full and partial internal models. The development of the capital intensity is displayed over the five reporting years for each undertaking, ranked according to capital intensities of year end 2020.

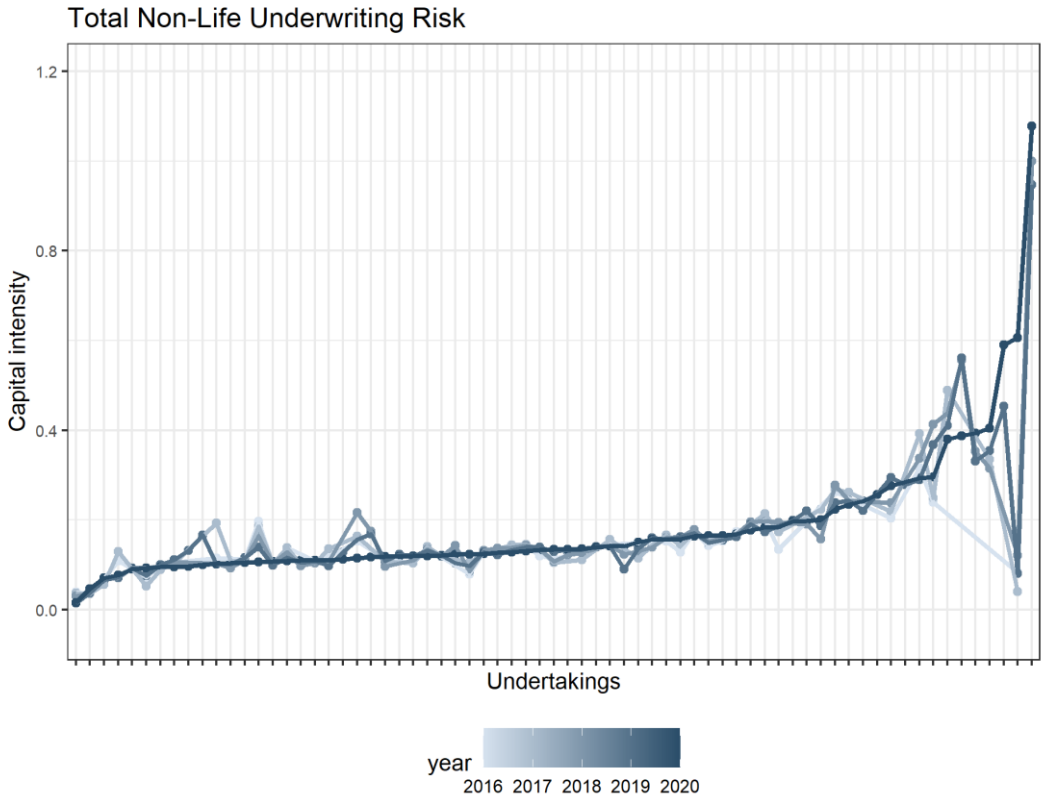

Figure 2 – Total NL risk capital Intensity over the 5-year analysis horizon (IM + SF) net of reinsurance[7]

The main body of the sample as well as most of the individual undertakings do not display significant developments after the initial approval of the internal models or in comparison to 2020. Furthermore, 90% total non-life risk capital intensities lie between 9% and 28.9% (for the NLCS sample across all reporting years). The average capital intensity is 16.9%.

Beyond these general observation of stability within the NLCS sample the project group identified a number of attention points, which were discussed in the individual feedback sessions, e.g.:

- On the left side of the chart there are some examples of very low capital intensities, and some undertakings display a steady decrease over time. A high number of the low capital intensities

[7] Graph excludes outliers, i.e. observations with capital intensity > 200%.

are linked to high profit expectations recognised with a non-centered risk measure in premium risk (for more information on the topic please refer to 6.2).

- On the right side of the chart, high volatility of the capital intensity is observed. Individual feedback sessions confirmed that undertakings on this side of the graph have experienced significant portfolio changes (e.g. M&As, portfolio transfers, general transactional business model) while some undertakings have observably high capital needs. In very few cases data issues were identified.

INTERNAL MODEL ONLY (IM ONLY)

Figure 3 displays the capital intensity development of the sample over the NLCS time horizon of 5 years for the total non-life underwriting risk limited to internal model results. The numbers on the top indicate an increasing number of data points for each year due to new model approvals over the 5 year time horizon. The black line represents the sample median, which is stable and ranges between 12.7% and 14%.

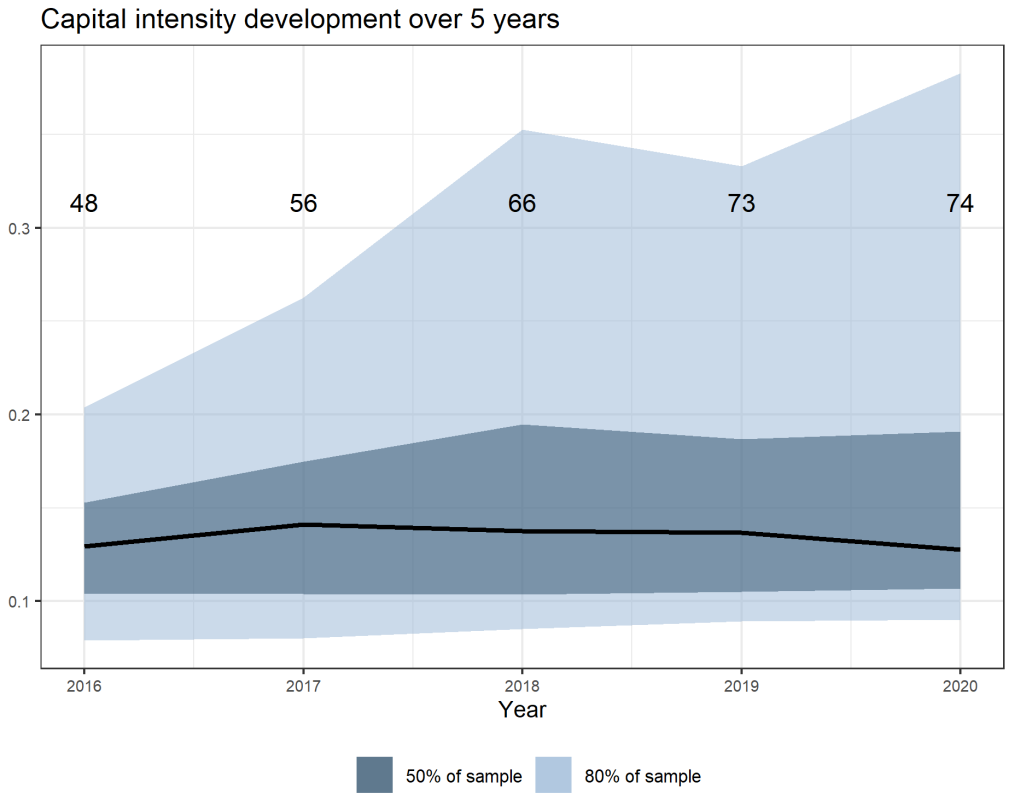

Figure 3 – Development of total NL capital intensity and sample (IM only) net of reinsurance

Based on more in-depth analysis the project group deduced that the additions of new data points up to year 2018 have mainly increased the variability. This also confirms the observations made in the previous section that individual undertakings results are relatively stable on a sample basis. This behaviour is confirmed with the relatively stable period of 2018 to 2020.

The stability in these 3 years is particularly remarkable as this includes the outbreak of the Covid-19 pandemic at end of 2019 and 2020, which means that the internal model undertakings projected no additional volatility and actually moderate reliefs in risk capital or capital intensity in 2019. Due to the timeframe of the study, any time lagged effects potentially observed in 2021 could neither be confirmed nor ruled out.

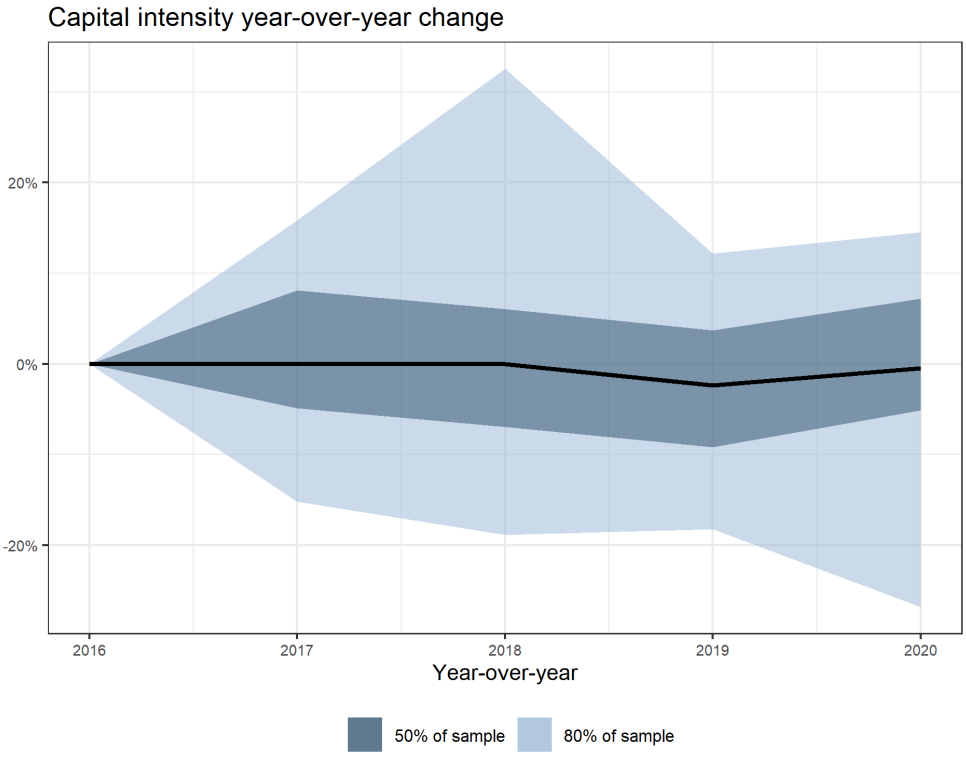

Figure 4 – Development of total NL changes of capital intensity (IM only) on an annualized basis net of reinsurance

Figure 4 displays the distribution of annual (year-on-year) changes for the same sample as above. This graph confirms the relative stability of results. While the outlier behaviour displays significant development, the majority of undertakings display only moderate year-on-year changes. The median year-on-year change is very close to 0, however, a slight downward trend of the median is

observed from year 2018 onwards. The highest changes are observed from 2017 to 2018. Over the 5-year time horizon, less than 50 % of undertakings have changed their capital intensity for more than 10% per year.

DRILLING DOWN

While the results on total non-life underwriting risk level display relatively low dispersions, results on lower granularities tend to be more extreme in line with modelled diversification effects.

In tendency results become more pronounced the lower the granularity and the more analysis get closer to portfolio levels or homogeneous risk groups (HRG).

At premium risk level, the year-to-year development of the capital intensity shows more volatility than the total non-life underwriting risk. In fact, the total variance for premium risk capital intensities (1.9 percentage points) is higher than for total non-life underwriting risk (1.6 percentage points), while the variance for reserve risk is 1.3 and for CAT risk 1.05 percentage points. Therefore in essence outliers dominate the variance of the studies sample.

5.2. PREMIUM RISK

INTERNAL MODEL AND STANDARD FORMULA (IM + SF)

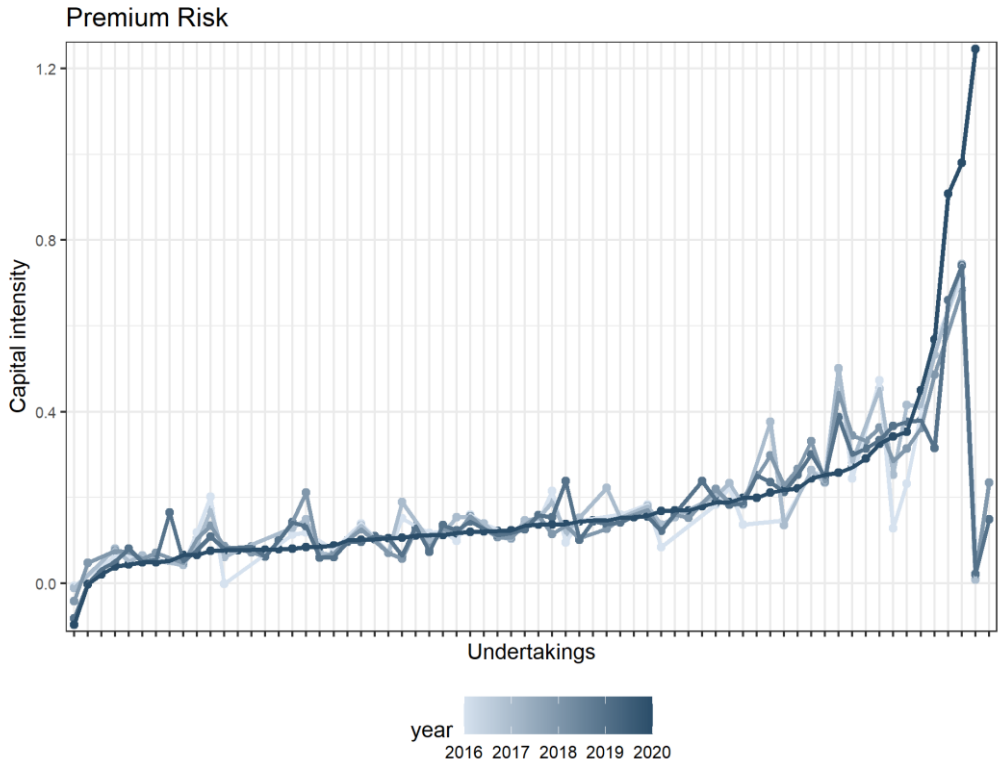

Figure 5 – Total premium risk capital Intensity over the 5 year analysis horizon (IM + SF) net of reinsurance

The main body in Figure 5 of the sample as well as most of the individual undertakings display moderate developments after the initial approval of the internal models or in comparison to 2020. Furthermore, 90% of the total premium risk sample lie between 5.5% and 32.7%, with an average of 16.5%. This is a much higher dispersion than observed for total non-life underwriting risk.

Notably two undertakings reported negative overall premium risk capital intensities due to negative risk capital. This methodology and impact, which leads to negative figures is discussed in section 6.2 on risk measure. Individual follow-up for these two companies are initiated by local NCAs.

INTERNAL MODEL (IM ONLY)

The NLCS uses the aforementioned boxplots for discussion of relative positioning in the context of premium risk. Figure 6 displays the capital intensity development of the sample over the NLCS time horizon of 5 years for the total premium risk only for internal model results (excluding modules

where calculation is standard formula-based). The left-hand side shows the capital intensity development, and the right-hand side displays the combined ratio as an indication of the profitability.

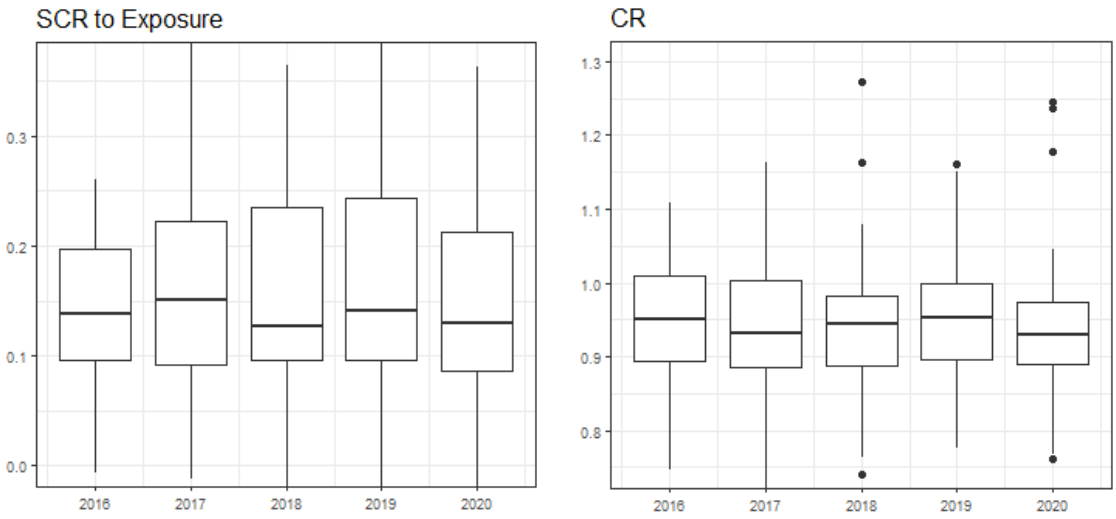

Figure 6 – Total premium risk capital intensity and combined ratio (IM only) net of reinsurance

The sample median of the SCR to Exposure, represented by the black lines within the boxes is stable and ranges between 12,7% and 15,1%. The additions of new data points up to year 2018 have not increased the variability of the sample to that extent observed in non-life underwriting risk. It is, however, also observable that outlier behaviour has increased over the 5 year time horizon. As it will be discussed in chapter 6.2 on risk measure, this development was mainly driven by the changes in the profit expectation. Particularly, for future business as represented in Figure 6 the development is driven by the positive development of the combined ratio (CR).

5.3. RESERVE RISK

INTERNAL MODEL AND STANDARD FORMULA (IM + SF)

The total variance for reserve risk capital intensities in Figure 7 is lower, due to the lower volatility on the upper end of the distribution, as annual underwriting changes take longer to materialise in reserve risk. The effect on the total non-life underwriting risk capital intensity, given the benefits of the risk diversification effects, is not as pronounced.

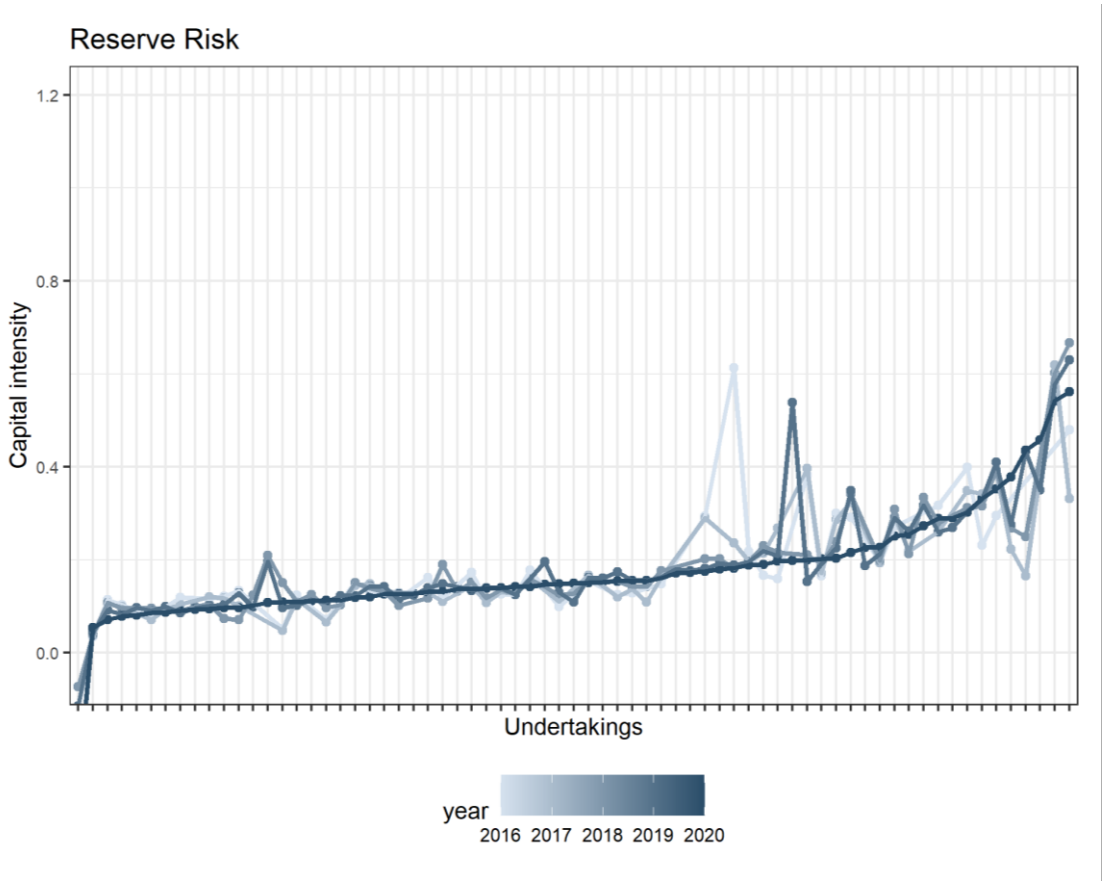

Figure 7 – Total reserve risk capital Intensity over the 5 year analysis horizon (IM + SF) net of reinsurance

For reserve risk 90% of the sample lies between 8.7% and 33.1%, averaging at 17.8%. One undertaking reported negative best estimate, which resulted in a negative risk capital intensity.

INTERNAL MODEL (IM ONLY)

Figure 8 shows a narrowing variability in reserve risk variability of the entire sample over the 5 year time horizon. The narrowing on to top end is a bit more pronounced than at the lower end.

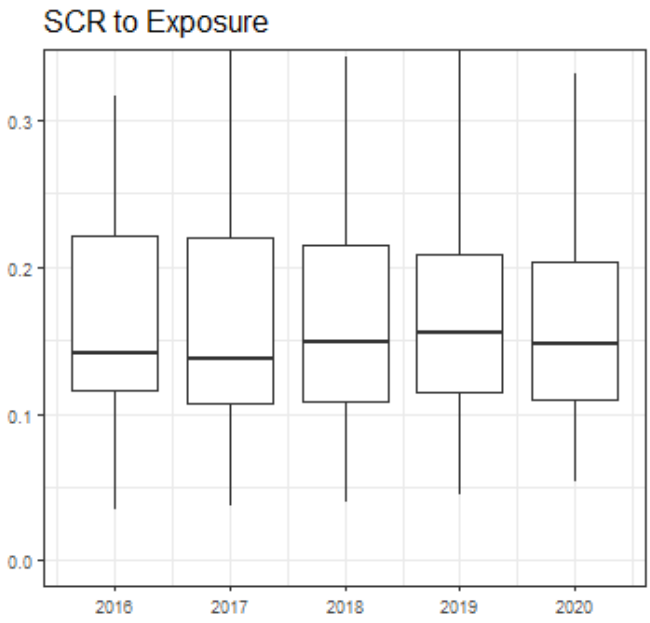

Figure 8 – Total reserve risk capital intensity (IM Only) net of reinsurance

5.4. CATASTROPHE RISK

Catastrophe risk data was only collected for reporting years 2018 to 2020. The same chart as for the other main risks was computed for this risk module.

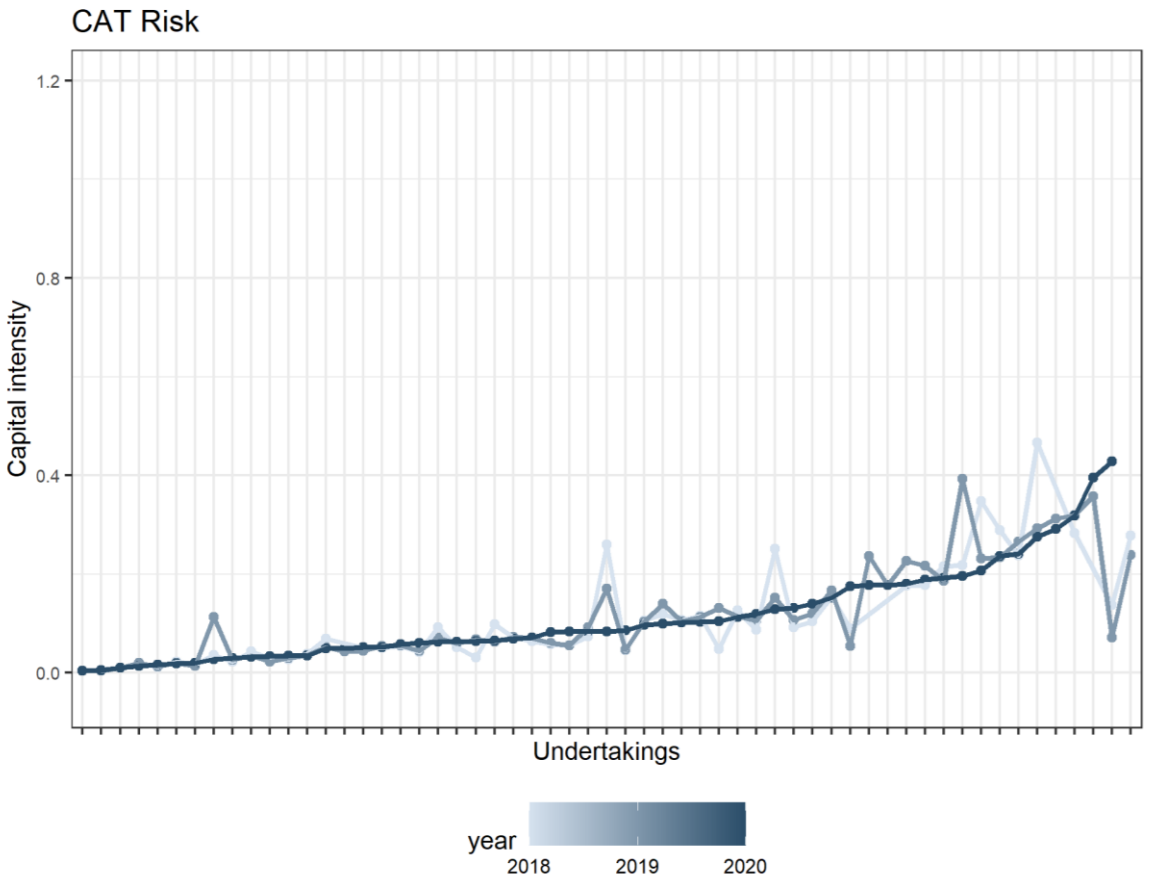

Figure 9 – Total CAT risk capital Intensity over the 3 year analysis horizon (IM + SF) net of reinsurance

The capital intensities are on average lower than those for the premium and reserve risk. 90% of the sample for all years lies between 2% and 26%. However, the chart is displayed for net of reinsurance values as catastrophe risk is mainly reinsured.

During the course of the study, further analysis on catastrophe risk were removed from the scope of this edition of the NLCS. They are, however, expected to be analysed for separate use and consumption within or beyond the supervisory community at another point in time.

5.5. CONCLUSION AND FOLLOW-UP

For the capital intensities within the highest two granularities of the overall NLCS sample, displayed in this chapter, no indication on model drift towards lower or higher capital intensities could be identified. This means that, on average, the participating undertakings did not increase or reduce risk capital per amount of exposure, indicating stability of capital allocation over time. For several participants, however, the project group observed outlier behaviour compared to the entire sample or other relevant peer groups.

In addition, it is observed that while the results on total non-life underwriting risk level display relatively low dispersions, results on lower granularities tend to be more extreme in line with modelled diversification effects.

At premium risk level, the year-to-year development of the capital intensity shows more volatility than the total non-life underwriting risk. In fact, the total variance for premium risk capital intensities (1.9 percentage points) is higher than for total non-life underwriting risk (1.6 percentage points), while the variance for reserve risk is 1.3 and for CAT risk 1.05 percentage points. Therefore, in essence, outliers dominate the variance of the studies sample.

Additional analyses have been performed to confirm the hypotheses that this effect propagates also towards lower granularities, i.e., results become more pronounced and disperse the closer the analysis moves toward portfolio levels or homogeneous risk groups (HRG). The performed analysis is described thoroughly in chapter 7 Drilling down – S2LoBs and IntLoBs.

Such initial outlier behaviour was complemented in the individual feedback sessions with in-depth risk profile decomposition as part of the individual feedback package. Understanding relative positioning of capital positions on different granularities is aiding an understanding of dominating factors. Since this approach is independent of the underlying methodologies the analysis explore and benchmark the modelled risk profile and actual business development in order to identify and analyse peer group behaviour further.

The analysis of capital intensities has helped to separate relevant issues from inconsequential observations of the high-level granularities total non-life risk, premium risk, reserve risk and catastrophe risk (for more information on the approach please refer to the Methodology chapter).

6. ANALYSIS HIGHLIGHTS

This chapter highlights and provides details on selected analyses conducted in this edition of the NLCS.

6.1. IM QRT READINESS

LINK TO FUTURE INTERNAL MODEL QRTS

The new uniform IM QRTs (from YE2023 onwards) allow a common approach in reading and processing the data of the templates. They support an EEA-wide comparison of model-relevant data and thus a common language.

In fact, this NLCS edition was in part designed as a prototype of the IM QRTs and shares a significant number of concepts and wordings since the IM QRTs were designed with very similar design choices.

The similarities in concepts of the templates allowed the project group to a certain extent to test within the NLCS the undertakings' ability to comply with the IM QRTS and to identify areas for necessary improvements early in the process (YE 2022). Furthermore, the 5-year time series of the NLCS allows supervisors to start with a reference point into the new IM QRT reporting.

DATA QUALITY

Most undertakings complied with the survey instructions and are able to attribute their results as required within the requested granularities with small adjustments. Nevertheless, a number of unsolved issues remained for a minority of undertakings.

In order to further increase consistency, some of the data subject to above issues were corrected by the NLCS PG after consultation with the NCAs and undertakings. Examples of correction include change of the exposure sign and parallel shift of the P&L distribution. Furthermore, cases of data unavailability raised concerns about the concerned undertakings' data governance. Several undertakings highlighted that they were unable to provide at least part of the requested information or to split it within prescribed granularities.

CONCLUSION AND FOLLOW-UP

The project group and NCAs have discussed with all participants their relative positioning with respect of the IM QRTs readiness in the individual feedback sessions. The ability of participants to respond to the NLCS survey was used as measure of data quality and use test.

Overall, the project group concluded that most undertakings are well prepared for the introduction of the IM QRTs under the assumption that the same information will be used as was provided in the submissions of the study. However, in some cases, insufficient data quality led to further activities and analysis by participating undertakings to address necessary improvements before YE2023.

6.2. RISK MEASURE

INTRODUCTION

Undertakings have different options to calculate the SCR: the standard formula (SF); undertaking specific parameters (or USP); or internal models (IM). In all cases the SCR shall be calibrated in such a way that all quantifiable risks to which an insurance or reinsurance undertaking is exposed to are taken into account.

Internal model users have flexibility in the way they model risk in order to reflect their risk profile appropriately.

Specifically Art. 122 (1) Directive 2009/138/EC defines that “Insurance and reinsurance undertakings may use a different time period or risk measure than that set out in Article 101(3) for internal modelling purposes as long as the outputs of the internal model can be used by those undertakings to calculate the SCR in a manner that provides policy holders and beneficiaries with a level of protection equivalent to that set out in Article 101.”

Since Solvency II is a principle-based framework, undertakings with internal model benefit from some degree of modelling freedom as long as they can produce equivalent protection levels compared to article 101 (3). Deviations are subject to supervisory approval and need to be explored, discussed and disclosed in the SFCR and ORSA. Conceptually internal models can produce higher or lower results than the standard formula.

This section analyses the observed approaches followed by undertakings when it comes to the consideration of expected profits for future business in the calculation of the non-life SCR. It includes a comparative analysis of different capital intensities (level playing field). Special attention is given to premium risk and future business, as this is the place where most differences were identified over the 5 year time horizon of the NLCS.

The initial edition of the NLCS was performed with only two years of data and a lighter dataset, but it paved the way conceptually for this second edition. The first edition concluded that the use of different risk measures can have a significant impact on the observed capital intensities and that these differences were linked to the treatment of expected profits.

Unfortunately, the available information at the time was limited and therefore not sufficient to conclude reliably on the appropriateness of the selected approaches.

Nevertheless, the project group developed a first version of a comparison based on a centered approach as outlined below. In this attempt a concept was introduced as defined in 4 for the UpLift in order to compare undertakings of the NLCS as fairly as possible within the same centered risk measure paradigm.

Therefore, the first edition of the NLCS identified the risk measure topic as a priority follow-up item for this study.

IM MODELLING OF NON-LIFE PREMIUM RISK

Most IMs covering premium risk derive the SCR via stochastic profit and loss (P&L) distributions or the modelling of the variation of individual balance sheet items (equivalent to P&L representation). The typical P&L approach creates stochastic scenarios of P&L distributions gross of reinsurance, which are, then, presented one by one to a reinsurance structure in order to arrive at a net of reinsurance P&L.

Every P&L follows typically some sort of accounting logic for premiums, expenses and claims. All three items can be stochastic but are not always. Typical distinction is made between attritional losses (typically in form of a loss ratio styled modelling) and large losses (typically in form of a frequency/severity styled modelling). Catastrophe claims are typically not part of premium risk but tend to be presented to the same global reinsurance structure.

The concrete implementation of this general framework is historically rich in approaches and may differ in many specificities. The NLCS output focus has, however, shortcut the differences in approach and allowed comparison between capital intensities of internal models.

For existing business subject to premium risk, the expected results are already incorporated in the best estimate (included on the premium provisions), so that the calculation of the SCR should not include any expected result (to avoid double counting of profits or losses), only the deviation from this expected result.

For the future business, however, the expected results are not incorporated in the best estimate, and two different approaches (risk measures) were identified:

- No consideration of the expected results (**centered approach**);
- Consideration of the expected results (**non-centered approach**) as a risk mitigant which increases (in case of expected losses)/reduces (in case of expected profits) the initial SCR calculation.

The standard formula operates from a zero profit assumption.

The study requested on the one hand a self-identification of the compliance with Article 101 (3) Directive 2009/138/EC, which included self-identification on the risk measure used. On the other hand, quantitative information was collected in order to support the modelled P&L distributions for all levels of granularity in order to challenge this self-identification with the UpLift indicator introduced in the chapter on Methodology 4. The UpLift itself is identical to a centered approach and therefore does not account for expected profits or losses. In this sense it puts undertakings on the same footing.

OVERALL PREMIUM RISK COMPARISON

Figure 10 displays the comparison of the overall NLCS sample based on the reported SCR as well as the calculated UpLift (centered risk measure estimated by the project group) for premium risk.

The left-hand side displays the capital intensity based on SCR produced by the approved internal model (SCR to exposure). The SCR to exposure ratio showed some particularly low values, and on occasions even negative SCRs for premium risk. Most of the low values were attributable to non-centered risk measure users with high profit expectations, particularly for future business as reported by participating undertakings.

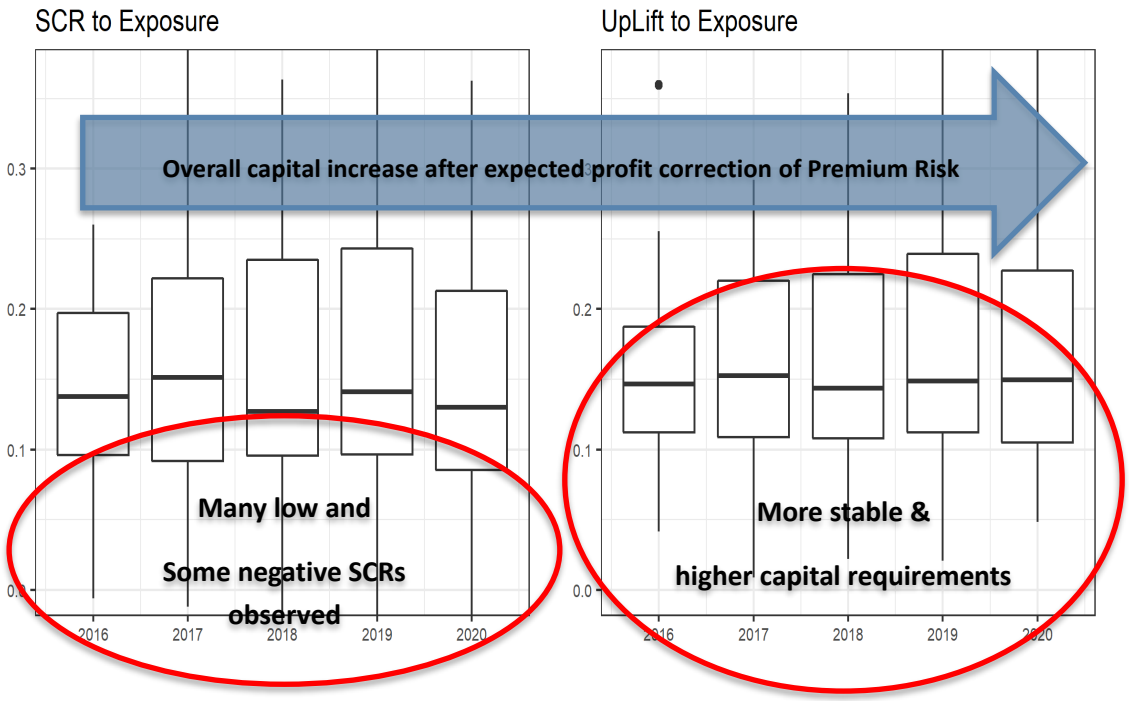

Figure 10 – Overview of the development of capital intensity and corrected capital intensity

On the right hand-side, the UpLift was used for comparison (Uplift to Exposure). The UpLift uses a centered risk measure for all participants as it removes the impact of expected profits for non-centered risk measure users. Therefore, the centered risk measure users' values remained at the same value while the non-centered risk measure users' values were corrected for their expected results (in most cases profits).

The impact of this correction was an increase for most non-centered risk measure users and the negative risk capital disappeared entirely. The resulting overall sample became more stable (less dispersed) as the year-to-year changes of profits did not impact the non-centered risk measure users.

This comparison confirms that most non-centered risk measure users have a conceptual and competitive advantage over the centered risk measure as well as standard formula users due to the profit expectations on the future business development. This unlevels the playing field in their favor.

With respect to profitability, no significant differences were observed between non-centered and centered risk measure users. Overall NLCS participants are mostly profit making and the sample moderately increased its overall profitability over the 5 year time horizon as can be observed in Figure 11.

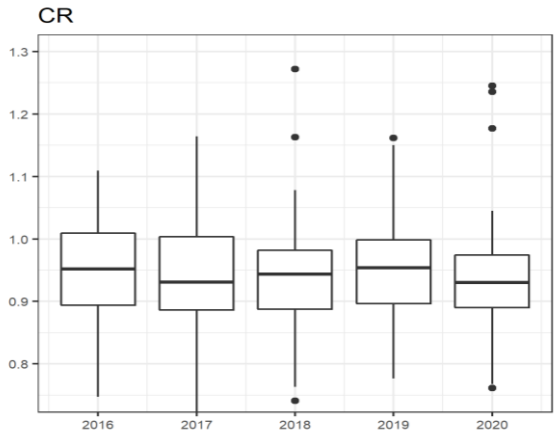

Figure 11 – Observed Combined Ratios (CR) of the overall NLCS sample

CONCLUSION AND FOLLOW-UP

The project group concludes that the use of a non-centered approach for the calculation of the SCR presents challenges to both the undertakings and the NCAs as it relies on an estimation of uncertain future profits.

Non-centered risk measure users typically show lower SCR due to future business profit expectations. The project group concludes that non-centered risk measure users tend to be outliers when compared to centered risk measure users. In extreme cases the expected future profits are

so high that the SCR becomes negative. In general an inverse relation is expected between risk and return.

6.3. STANDARD FORMULA COMPARISON

INTRODUCTION

The standard formula comparison has been established over the course of two NLCS studies as one of the most effective standardised benchmarking comparisons. It is mainly based on distribution moments and individual moments and categorises undertakings into broad categories and peer groups.

The benchmark analysis itself compares the realised IM KRI's against the standard formula ones with respect to:

- **Capital intensity:** a measure of the actual capital required for a given portfolio (see chapter Capital intensity)
- **Unit volatility:** a measure for the uncertainty of results
- **Multiplier:** a measure for how uncertainty translates into risk capital

In the following paragraphs the KRI's are introduced in more depth.

Capital Intensity

This analysis aims at comparing the IM capital intensity with the standard formula (SF) framework. The capital intensity is defined slightly different than in the methodology chapter, as for premium risk, the earned premium was only considered as exposure measure.

The standard formula framework provides a standardised approach for the SCR calculation. Within the non-life underwriting risk, the capital requirement for the sub-modules premium and reserve risk is calculated[8] as

$$SCR = 3 \cdot \sigma \cdot V$$

where

- σ denotes the standard deviation for non-life premium and reserve risk and
- V denotes the volume measure for non-life premium and reserve risk.

[8] Article 115 of the Delegated Acts.

This formula is based on a number of hypotheses, the most relevant one being the lognormal behaviour for the profit and loss (P&L) distribution. In case of a normal distribution of the P&L, the relation that would hold would be

$$SCR = 2.58 \cdot \sigma \cdot V$$

with the same definitions as above for σ and V. Given that the capital intensity is defined as the SCR divided by a volume measure, the internal model capital intensity can be compared against $3 \cdot \sigma$, since

$$\frac{SCR}{V} = 3 \cdot \sigma$$

The σ within the SF framework are defined in the Delegated Acts and vary by line of business. For the premium risk, when calculating the SCR net of reinsurance, the σ shall be multiplied with an adjustment factor for non-proportional reinsurance[9]. All quantities are summarized in the following table.

Segment	σ Premium Risk	σ Reserve Risk	Adjustment for non-proportional reinsurance
MTPL	10%	9%	80%
OtherM	8%	8%	80%
FIRE	8%	10%	100%
GTPL	14%	11%	100%
C&S	12%	19%	100%

The analysis has therefore been performed separately for each focus line of business. The capital intensity ratios have been computed at S2LoB granularity. Their distributions among undertakings have been plotted for each reporting year in a separate boxplot and compared against the standard formula threshold.

The results have been discussed during the individual feedback sessions with undertakings which, at least once in 5 years, presented capital intensity lower than 25th percentile of the overall distribution.

Unit Volatility and Multiplier SCR/SD

The capital intensity ratio can be extended in the following way:

[9] Article 117 and Annex II of the Delegated Acts.

$$\frac{SCR}{V} = \frac{SD}{V} \cdot \frac{SCR}{SD}$$

where

- SD denotes the standard deviation of the profit and loss distribution

The first ratio on the right side of the equation, $\frac{SD}{V}$, can be interpreted as the unit volatility of the profit and loss distribution.

> The **unit volatility** is the volatility per unit of exposure.

The SD of the profit and loss distribution is normalised, therefore can be compared with the σ from the standard formula.

The second ratio on the right side of the equation, $\frac{SCR}{SD}$, gives information about the shape of the profit and loss distribution. The standard formula assumes that this value is equal to 3. In case of the normal distribution, this value is equal to 2.58.

These two ratios have been computed at S2LoB for each focus line of business. Their distributions have been plotted for each reporting year in a separate boxplot and compared against the standard formula threshold.

The general purpose of the equation considered is to analyse the level of capital intensity, since it depends both on the unit volatility of the business and on the value of the $\frac{SCR}{SD}$ multiplier.

> The **multiplier** is the relationship between risk capital and standard deviation, which allows to categorise the fat-tailed-ness of the distribution.

For many companies, across the four S2LoBs analysed, among those that have shown a low capital intensity, the $\frac{SCR}{SD}$ multiplier ranges inside the two thresholds for almost all the years. On the other hand, lower values than the standard formula σ have been often observed for the unit volatility, meaning that a low capital intensity is in general caused by a unit volatility lower than the standard formula values.

Figure 12 benchmarks internal model results against the standard formula values for the three indicators over the 5 year time horizon for one S2LoB (Direct FIRE business). For the individual feedback sessions these results were overlaid with results of individual undertakings and groups. This approach allowed to compare concrete internal model selections against relevant peers. In the

first two graphs the red dotted line represents the standard formula equivalent value, and the yellow line represents the medians average across the 5 years considered.

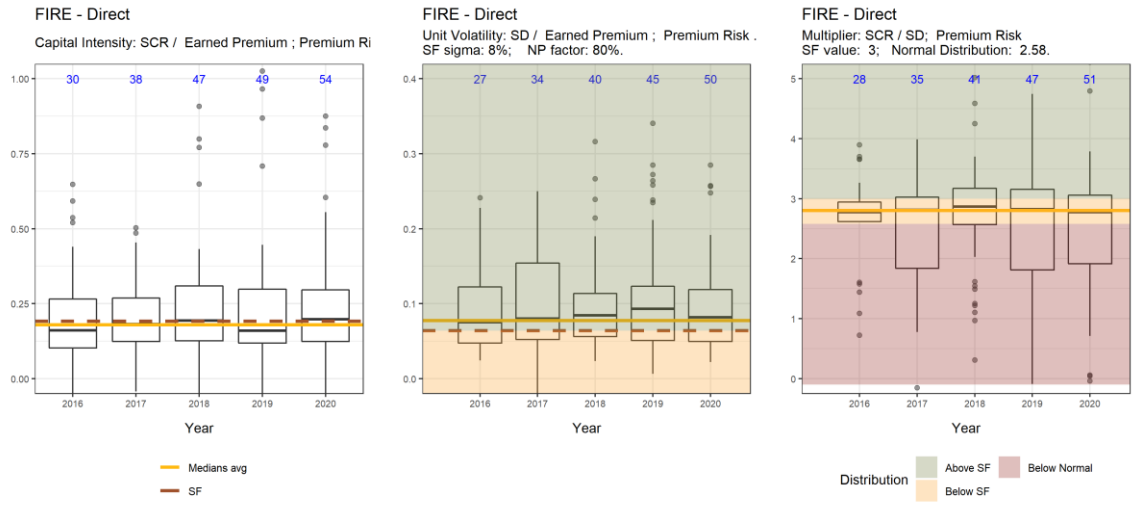

Figure 12 – Example for standard formula benchmarking for direct FIRE business

OVERVIEW OF RESULTS

Table 1 and Table 2 display the median result of 2020 for the three KRIs (capital intensity, unit volatility and multiplier) developed for standard formula comparison, for all 5 focus S2LoBs of this study, separately for premium and reserve risk.

Premium risk

For premium risk FIRE, MTPL, GTPL & OtherM, IM results in Table 1 were reported lower for capital intensity and unit of exposure than would be expected by the standard formula. At the same time the distribution types were moderately tamer or close to the standard formula distribution type.

This means that a typical internal model undertaking benefits for these four S2LoBs from lower capital intensities than standard formula would due to tamer volatility and distribution selection as well as direct reinsurance modelling. The results are more pronounced for profit-making undertakings with a non-centered risk measure as discussed in 6.2. Graphical analysis confirm that distribution types tend to be tamer and volatilities tend to be lower.

C&S shows higher values for all three KRIs, but this seems to be in part coupled with the higher risk and volatility of the trade credit insurance sub-risk in comparison to the suretyship business, as well as the treatment of catastrophe risk. More information on C&S can be found in 7.7.

Premium Risk	Capital intensity		Unit volatility		Multiplier	
S2LoB	**IM**	**SF**	**IM**	**SF**	**IM**	**Distribution type**
OtherM	0.132	0.24	0.0579	0.08	2.68	Between SF and normal
MTPL	0.201	0.3	0.0717	0.10	2.81	Between SF and normal
GTPL	0.296	0.42	0.109	0.14	2.87	Close to SF
FIRE	0.198	0.24	0.0788	0.08	2.8	Between SF and normal
C&S	0.724	0.36	0.228	0.12	3.1	Above Log normal

Table 1 – Premium risk comparison of IM KRIs median result in 2020 against standard formula for direct business

Reserve risk

For reserve risk the results are not as analogous as for premium risk.

The S2LoBs MTPL and GTPL, which are characterised by a long-tail business[10], continue to show internal model results analogously to Table 2 with lower capital intensity and unit of exposure than would be expected by the standard formula. At the same time, the distribution types were moderately tamer or close to the standard formula distribution type. This means that for the two reserve risk dominated liability lines MTPL and GTPL a typical IM undertaking enjoys lower capital intensities also for reserve risk.

Again, this observation can be linked to tamer volatility and distribution selection as well as direct reinsurance modelling.

C&S shows higher values for all three KRIs. The considerations are the similar as for premium risk. More information on C&S can be found in 7.7.

[10] The time between claim reporting and settling in these two lines of business can be very high. Therefore, the predominant risk is the reserve risk.

Reserve Risk	Capital intensity		Unit volatility		Multiplier	
S2LoB	**IM**	**SF**	**IM**	**SF**	**IM**	**Distribution type**
OtherM	0.33	0.24	0.123	0.08	2.74	Between SF and normal
MTPL	0.174	0.27	0.0644	0.09	2.73	Between SF and normal
GTPL	0.185	0.33	0.0707	0.11	2.86	Close to SF
FIRE	0.316	0.3	0.114	0.10	2.89	Close to SF
C&S	0.709	0.57	0.21	0.19	3.25	Above Log normal

Table 2 – Reserve risk comparison of IM KRIs median result in 2020 against standard formula for direct business

CONCLUSION AND FOLLOW-UP

Detailed individual feedback and relative positioning was provided during individual feedback sessions. The project group identified as outliers participants with capital intensity lower than the 25th percentile of the overall distribution at least once over the 5-year time horizon. For those undertakings, further information about unit of volatility and multiplier were used for the assessment of the undertakings' behaviour. Low capital intensity can be caused mainly by lower than standard formula equivalent unit volatility, while the multiplier lies in general between Normal and Log-Normal hypothesis.

Outlier behaviour is followed up by NCAs on individual undertaking and group basis. Internal model users with non-centered risk measure contributed over proportionally to outliers in all the KRI analysis.

This comparison and its benchmarking proved to be simple, relevant and conclusive for comparative analysis across granularities. The analysis can be replicated with the new IM QRTs.

6.4. INFLATION

Due to very stable inflation levels observed, i.e., around and below the two percent target of the ECB, for the two decades preceding the design of this study in 2020, the project group decided initially not to collect specific information on inflation.

The Russian aggression in Ukraine and global supply chain bottlenecks changed this initial assessment. Inflation was set as a priority topic on the supervisory agenda in 2022. Since no

additional information could be requested for the scope of the NLCS at that time, the project group decided to use the available information on time value of money to explore potential impacts by developing dedicated stresses.

The outcome of the stresses, complemented by conversations with participants during the individual feedback sessions, are presented in this section. The statements made rely on the information available at the time of the analysis and only address non-life underwriting risk effects.

IMPACT OF INFLATION ON NON-LIFE RISK

Inflation has an immediate direct impact on the level and development of paid claims and claim reserves with a strong tendency to display the following behaviour:

- **Stable inflation levels:** If past and future inflation operate on comparable levels this is not a problem as all products as well as claims reserves estimations have explicit or implicit assumptions on inflation, which is reflected in the technical side the profitability of insurance business (netted cash flow levels of premiums against commissions, expenses and claims).
- **Changing inflation levels (past and future):** If inflation starts to deviate from historic inflation, insurance undertakings have to recognize and quantify the aspects on existing contracts or back-book in their economic Solvency II balance sheet. In addition, undertakings face increased uncertainty due to a changing environment. This is particularly relevant for the case of internal models.

Most internal model undertakings model inflation within non-life underwriting risk implicitly and they are, therefore, well prepared for the first situation, where inflation is expected to develop similarly as in the past (or develops at least slowly enough to be recognized over time).

For the second situation however, these undertakings have to use ad-hoc expert judgement since the past inflation in their data is not anymore a good estimation of future inflation levels (and uncertainty). Discussions at individual feedback sessions indicate that the undertakings will adjust their approach with expert judgement as their methodology does not necessarily account for this new situation.

Undertakings modelling inflation explicitly can address this situation directly, but they are at least to a certain extent dependent on the update cycle of vendor model providers for economic scenario generators.

OBSERVED INDUSTRY SENTIMENT

Individual feedback sessions

Within the individual feedback sessions, the project group and NCAs collected opinions of the participating undertakings on the impact of the sudden change of inflation levels observed in 2022.

Almost all undertakings agreed that they experienced impact from increased inflation levels, which will impact their technical result through the incoming claims data. Most insurance undertakings estimated that it was likely that only two quarters of actual claims experience of prevalent inflation levels would be reflected in their data. Some globally active reinsurers, furthermore, agreed that the data basis for them would be even less as they receive accounts from insurance undertakings normally after additional delay.

As most undertakings agreed with the second question, they expect that their assumptions and outlook requires adverse adjustments. Nevertheless, there was little consensus on how much of an impact would be recognised within undertakings balance sheet due to this shift in expectation. Timeseries of annual results use for parameterisation of underwriting risk typically 5 to 15 years.

The impact of half a year of data with higher inflation levels may be statistically not significant, there was however an understanding that the inflation and interest environment had changed adversely. Furthermore, undertakings highlighted that a high number of projects are ongoing internally to get a better grip on the outlook for year-end 2022. A significant number of participants highlighted that they expect to strengthen their best estimate reserves after netting of inflation and interest (e.g. RFR).

An exception may be credit insurers, which collect collaterals. During feedback events, some suretyship insurers mentioned that the market value of collaterals increases with inflation. In the event of default, the underlying is likely to be sold at higher value, reducing the potential loss of the insurer therefore inflation has a dampening effect on the technical results in these cases.

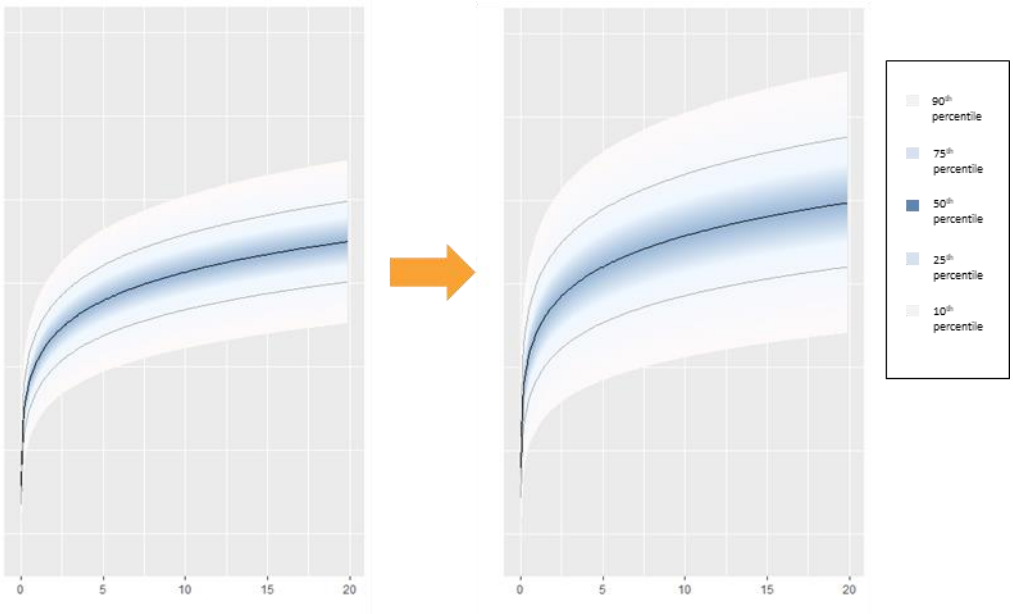

Figure 13 – Illustration of expectation and risk adjustment due to inflation

Reserve risk

The observed change in data and in expectation of undertakings indicate an increase in best estimate, which should lead for reserve risk (year-end 2022) to an increase of SCR as well as to second round effects. Undertakings were split on the amount of the increases both for best estimate as well as for SCR.

Some undertakings assumed that increases would be in line with the increase in reserves (no effect on capital intensity), other undertakings expected an additional increase beyond the relative increase of the best estimate. Almost all participants agreed that their business development has entered more uncertain times due to the environment changes due to the Russian aggression.

All undertakings confirmed that they are monitoring inflation at the moment with high priority.

Premium risk

For premium risk undertakings were confident that they would be able to pass on increased production costs to policy holders. Some undertakings were concerned however on how the competitive landscape would react to rate increases across the board.

All undertakings confirmed that they are monitoring inflation at the moment with high priority.

RESERVE RISK STRESSES

The project group explored the vulnerability of the NLCS sample with respect to inflation, interest rate development and outlook. For this purpose, a very simple stress approach was developed based on the HICP (Harmonized Index of Consumer Prices) of the ECB on EUR level. This very general inflation index was chosen since at the time more targeted information was not available in order to build more accurate inflation exposure buckets, e.g. with respect to underlying types of inflation.

It is worth mentioning that the stresses in this section assume that claims occur as expected, only inflation experience and outlook change in line with the RFR expectation. Any additional portfolio related adverse development or uncertainty of results would come on top of the modelled stresses.

Stress concept

Starting from the submissions for year-end 2020 participants' overall best estimate reserves were stressed with the inflation and interest levels as experienced in 2022 Q3 of the HICP. The stresses themselves relied on the modified durations and (un)discounted the time value of money with an effective inflation (inflation netted with RFR).

Undertakings mostly confirmed that this simplified approach can be used at least for a simplified stress and can serve as a lower threshold as specific inflation tends to be more pronounced than general inflation.

Discussion of (HICP) inflation forecast index

The implicit assumption underlying the stress is that at year-end 2020 all reserves were at least valued at an inflation level as observed by the HICP of the ECB and discounted on a comparable level of the RFR.

The HICP inflation forecast publishes annual rates of change of CPI (Consumer Price Index of EUROSTAT) as well as an outlook based on expert judgment of professional forecasters. Therefore, the benefit of the HICP is that it does not only track the observed inflation but also predicts inflation for 1, 2 and 5+ years. It, therefore, provides an implicit term structure, which allows comparing inflation observations and expectations over time.

Stress scenarios

While inflation assumptions are varying by undertaking the project group assumed that the inflation effect should be at least in the dimension of the HICP. Therefore, the index operated as a lower threshold since it is understood that specialized claims inflation tends to be above general inflation.

As inflation and interest rates are of course linked, the stresses analysed here include already changes of inflation and RFR as a netted effect. The following stresses were developed:

- **Central scenario:** Estimate impact of the 2022 Q3 inflation environment with an as-if stress on inflation and RFR.
- **Contagion scenario:** A gradual adjustment of forecasted expectation recognizes increasing mid- and long-term inflation levels. The inflation outlook for the first 4 years was expanded beyond recent expectation.
- **Base point scenarios:** Assumption that the netted inflation is expanding by given number of basis points across all maturities (50 Bps, 100 Bps , 150 Bps and 200 Bps)

Capital intensity

The project group inspected in a first step the impact of the stresses equivalent to the capital intensity. For this purpose, the change imposed by the change in inflation and RFR was divided by the initial best estimate value. Figure 14 shows that the observed capital intensity stresses are comparable to the medium-lower end reserve risk capital intensities, even though it is a one item stress. This means that the stresses are significant for reserves of the relevant participants.

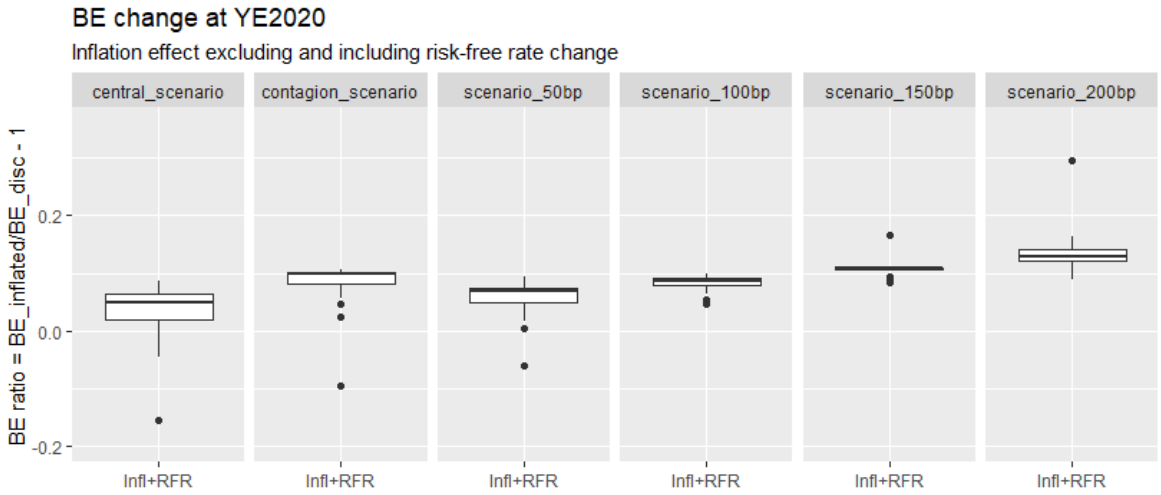

Figure 14 – Capital intensity equivalent inflation stresses

Performance of scenario scoring

When looking at individual results the project group noticed that for some of the undertakings the observed stresses were significantly eroding or even surpassing the reported reserve risk capital intensities.

The change in the central scenario is significant but does erode only for minority of participants the capital intensity. In the case of the contagion scenario, however, the majority of participants use more than 50% of the SCR only by inflation.

For the base point scenarios a relatively linear increase can be observed, whereby the 150 basis point scenario provides a comparable impact to the contagion scenario.

This indicates that significant additional risk could be accumulated if inflation trajectory continues or claims inflation is higher in some markets or currencies. Additional analysis on lower granularities indicate that individual lines of business can be subject to higher and more targeted inflation.

For transparency individual stresses were shared during the individual feedback sessions and undertakings were encouraged to provide feedback.

CONCLUSION AND FOLLOW-UP

The project group sees overall space for undertakings to increase their risk capital in order to allow for the experienced volatility and increased uncertainty of inflation levels going forward. From a technical result perspective, it will be key to understand for how long inflation will stay above the 2% target, which held true for more than 20 years.

Given the sentiment observed from undertakings, NCAs can expect that best estimate claims provisions will be influenced by changes on inflation and changes in interest rate (term structure). Similar holds true for other risks within the non-life underwriting risk as in 2022 mostly new contracts could not be underwritten. NCAs can furthermore expect analysis in the ORSA and reparameterization irrespective if undertakings model inflation explicitly or implicitly.

The project group has provided NCAs and undertakings with stresses based on the available information as a European-wide reference point, which can be used as vulnerability indicator. NCAs, undertakings and project group discussed during the individual feedback sessions the relative position and vulnerability of individual undertakings. Some conversations with undertakings continued following the individual feedback sessions.

Finally, the analysis laid out in this section supports the supervisory conversations and SRP of NCAs for year end 2022 submission going forward.

For some of the undertakings it would be useful to start a conversation about their readiness to sustain medium term stresses of increased netted inflation-RFR stresses. Most undertakings agreed that inflation as a topic will be discussed in ORSAs and or in IM reparameterizations.

6.5. DIVERSIFICATION

INTRODUCTION

The SCR captures the worst Profit and Loss that is observed in 1-in-200 years. Typically, statistical distributions which allow to derive future P&Ls for different (sub)risks and underlying products are constructed and therefore permit to derive granular SCR e.g. for premium risk for MTPL. However, the worst P&Ls between different LoBs and sub-risks might not occur simultaneously. To derive the total distribution and SCR, the dependencies or diversification between these risks and lines of business need to be captured as well.

It is observed that undertakings often model different levels of diversification to structure the diversification methodology. The total distribution can be derived from the underlying distribution of risks such as Market, Credit, Non-Life, Health and other risks. Furthermore, non-life and health underwriting risks are often themselves an aggregation of premium, reserve, catastrophe and other risks. Lastly, premium and reserve risk as well as catastrophe risk on the one hand are respectively an aggregation of lines of business and perils as shown in Figure 15 below.

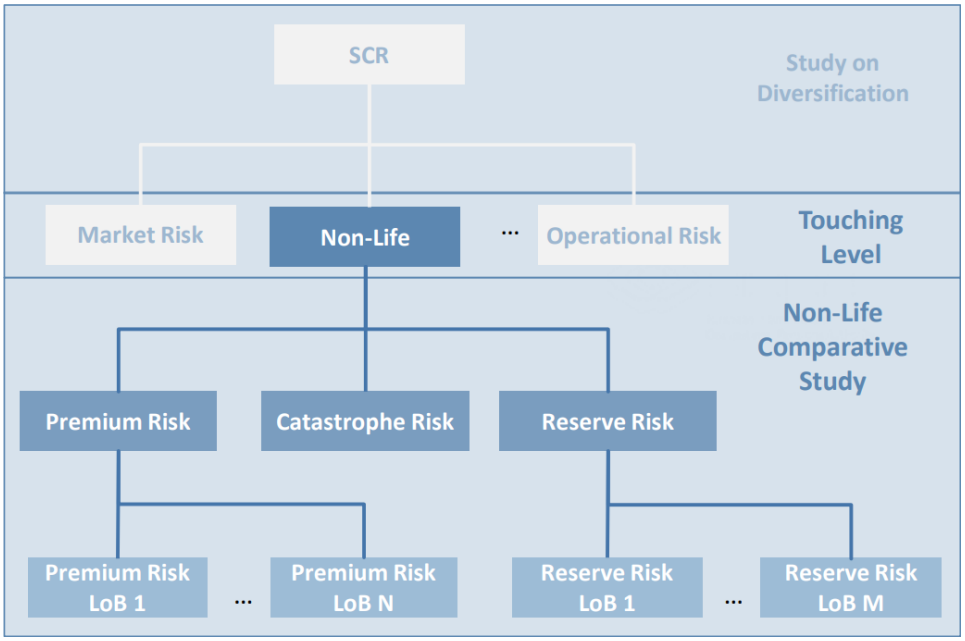

Figure 15 – Schematic aggregation tree for risks

These different levels of aggregation for non-life internal models are analysed within different project groups:

- The top-level diversification between risks (e.g. between market, credit, non-life, health and other risks) is captured in the DivPG.
- The mid-level diversification between sub-risks (e.g. g between premium, reserve and catastrophe risks) is captured within NLCS.
- The lower-level diversification (e.g. between lines of business within premium risk, between lines of business within reserve risk or between Perils between Catastrophe risk) is captured within NLCS.
- The geographical diversification is not analysed, and the other levels of diversification are corrected for geographical diversification to allow for an improved comparison between different insurers.

STANDARDISATION

Solvency II allows for modelling freedom such that undertakings can reflect as correctly as possible their risk profile. These differences in methodologies might however imply that correlations are measured in a different way and differences are purely driven by different risk definitions that undertakings make use of. To assure that the measurement of dependencies is not biased by

differences in methodology, the reporting in NLCS was constructed to allow for a standardization of risk definitions.

The main methodological differences observed are the following:

- The modelling according to accident year (as often used by retail insurers) or by underwriting year (as often used by commercial insurers and reinsurers);
- The modelling of man-made catastrophes implicitly within premium risk or explicitly in a separate module (often driven by the materiality of the property exposure)
- The modelling of inflation explicitly within market risk or implicitly within non-life
- The modelling of geographical footprint (separately or at an aggregate level)

Differences in risk profile	Difference in modelling	Standardised reporting
Betweeen **insurers and reinsurers**	Accident Year vs. Underwriting Year	Shift of unearned reserve risk for Underwriting Year models
Between insurers with **differing exposure in property**	Separate modelling of Man-made CAT or included in premium risk	Focus on dependencies of premium risk including man-made CAT
Between more or less **inflation-sensitive** insurers	Separate modelling in market risk or in claims triangles	Focus on non-life risk including possible inflation risk
Between insurers with different **geographical footprint**	Seperate modelling per geography or aggregate approach	Split between geographies (exclude geographical diversification)

Table 3 – Table of observed differences

To correct for these model differences, standardization in the reporting was introduced. To allow for a comparison between accident and underwriting year models and often between insurers and reinsurers, a correction was performed for the unearned reserve risk. In Figure 16 below an overview is shown of how accident and underwriting years are defined. The diagonals relate to underwriting years or when the premium was paid. The verticals relate to accident year or when the claims occurred.

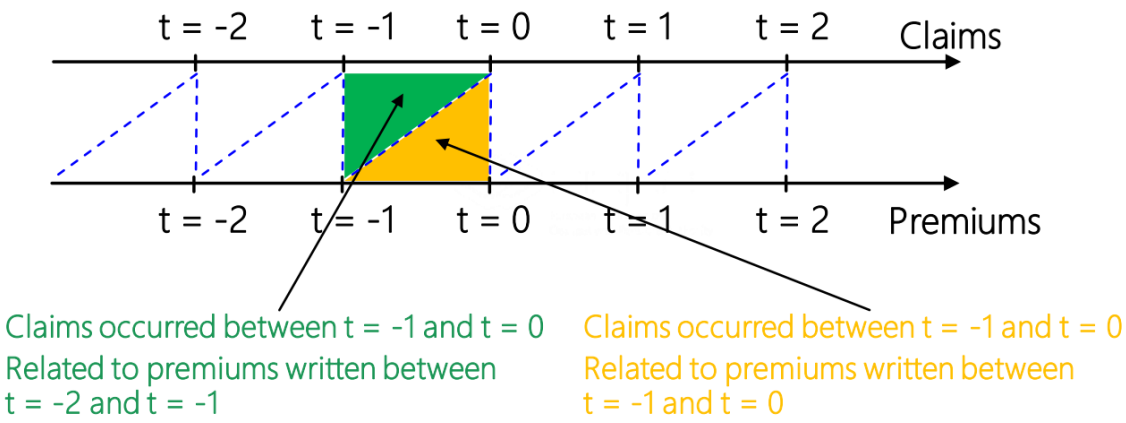

Figure 16 – Schematic of the timing relationship between premiums and claims

Based on these definitions for accident and underwriting years, the typical risk definitions for premium and reserve risk are shown in the Figure 17 below.

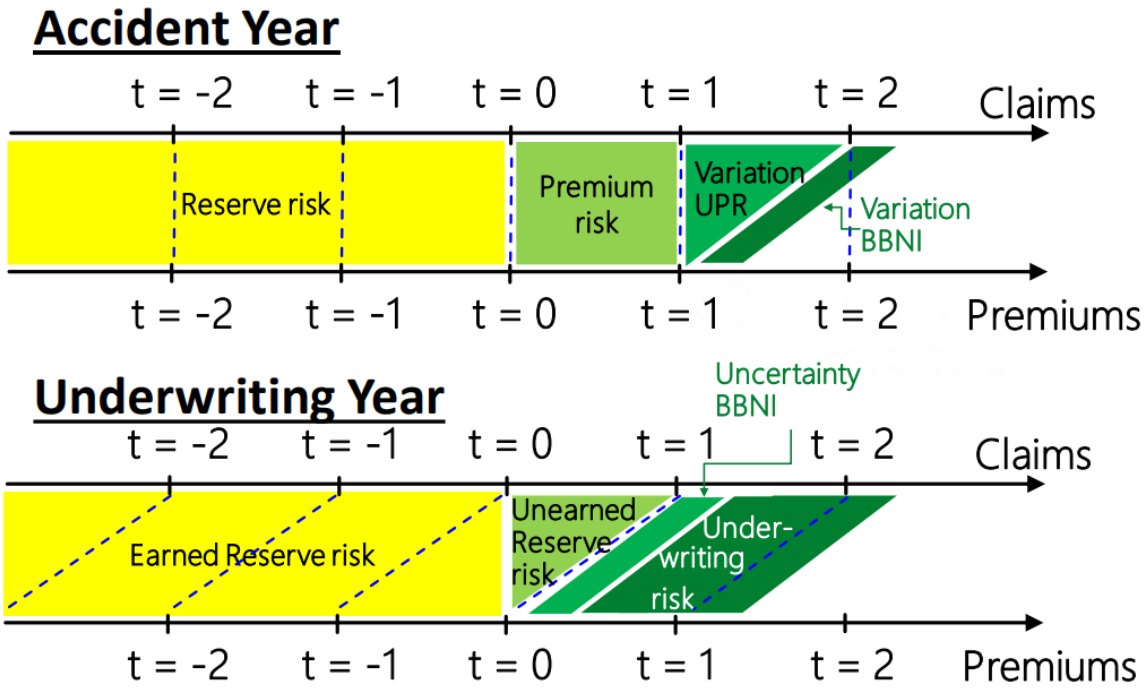

Figure 17 – Schematic of differences of equivalent accident and underwriting year statistics

For accident year models, reserve risk is defined as the uncertainty on past accident years and premium risk is related to the uncertainty in the following accident year. However, since not all premiums will be earned in this following year, this will result in the variation of the unearned premium reserve (or UPR). Furthermore, if certain premiums are bound at the end of this first future accident year, also bound but not incepted business (or BBNI). However, often for underwriting year models, reserve risk is defined as the uncertainty on past underwriting years. The future underwriting year will contain the uncertainty on the BBNI captured in the premium provision. However, the underwriting risk will often contain a year of business beyond the BBNI.

To allow for a more appropriate comparison between both types of risk, a standardised risk definition can be used for reserve and premium risk. If the standardised premium risk contains the following elements:

- For an accident year model:
  - The premium risk senso strictu
  - The variation of the UPR
  - The variation of the BBNI
- For the underwriting year model:
  - The unearned reserve risk
  - The uncertainty on the BBNI
  - The underwriting risk

It is clear that this in practice implies that the unearned reserve risk (which captured the uncertainty on future accident years, but past underwriting years) is therefore shifted from reserve risk to premium risk for underwriting year models. This standardised definition allows therefore a consistent comparison of both accident and underwriting year models as well as of insurers and reinsurers.

MEASUREMENT

Different analyses are performed to measure pair-wise dependencies. A first analysis concerns the measurement of the Pearson correlation. This is the bivariate correlation measure between P&Ls. It is the most commonly used dependency metric. However, it is also influenced by the marginal distributions and therefore can differ when comparing heavy-tailed to light-tailed marginal distributions.

A second metric is the Spearman correlation. This measure is based on the statistical ranks of P&Ls. It is, therefore, not influenced by the marginal distributions and is a pure dependency metric. However, since all ranks are used to determine the Spearman correlation, both ranks in the body of the dependency structure as ranks in the tail of the structure. Since some undertakings make use of dependency structure with mild correlations in the body, but stronger dependencies in the tail, this measurement might not captured this features.

A third metric is the joint quantile exceedance probability (or JQE). It counts the number of simulations for which both marginal distributions jointly exceed a specific threshold defined as a quantile. The JQE is defined as a ratio compared to the total number of simulations. This implies that the metric is not influenced by the marginal distributions and moreover it is a measurement of the dependency that occurs in the tail of the dependency structure. In Figure 18 below, a graphical representation is shown of the JQE which represents the number of simulations in the green box (jointly beyond the 80% quantile) divided by sum of the green and the brown box (where one variable is beyond the 80% quantile irrespective of the value of the other variable).

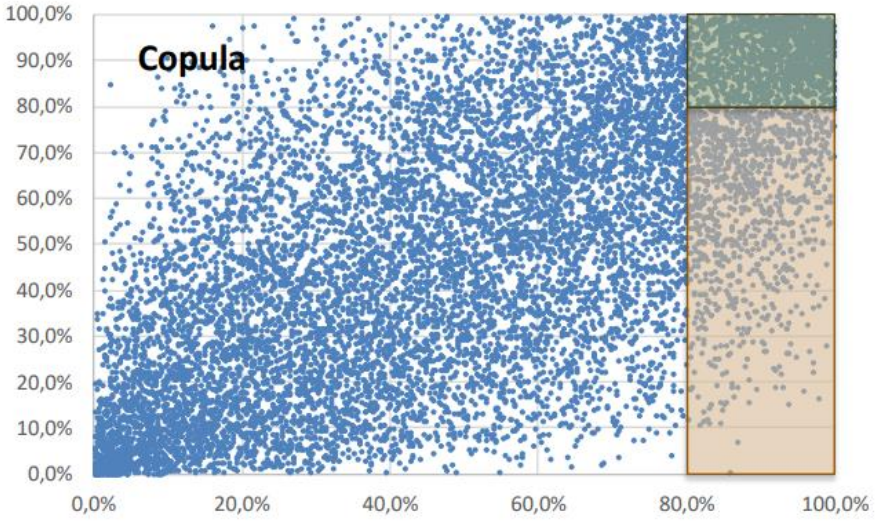

Figure 18 – Schematic on Joint Quantile Exceedance (tail dependencies)

The values for the different metrics are shown in Table 4 for the cases of perfect dependence, independence and perfect independence:

Legend	Perfect Negative Dependence	Independence	Perfect Positive Dependence
JQE_N_80	0%	20%	100%
Pearson	-100%	0%	100%
Spearman	-100%	0%	100%

Table 4 – Comparison of dependency values

Next to the different measures which are used, comparisons are also made at different levels (between non-life subrisks and between lines of business for a specific subrisk). A comparison is made purely between undertakings to detect whether a level playing field exists. Secondly, a comparison is made across time to assure that there is no model drift. Lastly, a comparison is made between the internal model output and the standard formula correlation to see which elements are driving the differences in capital requirements between both calculations.

ANALYSES

A first analysis consists in the comparison of the Pearson correlations computed at the second level of granularity of the study (among premium, reserve, and natural catastrophe risks) for data reported at year-end 2020. The correlation of the standard formula is also shown (yellow diamond). It is mostly clear that the correlations between premium and reserve risk show a larger dispersion and are often lower than the standard formula which lies at 50%. The correlation between premium risk and natural catastrophe risk shows a mild dispersion and is often higher than the standard formula at 0%.

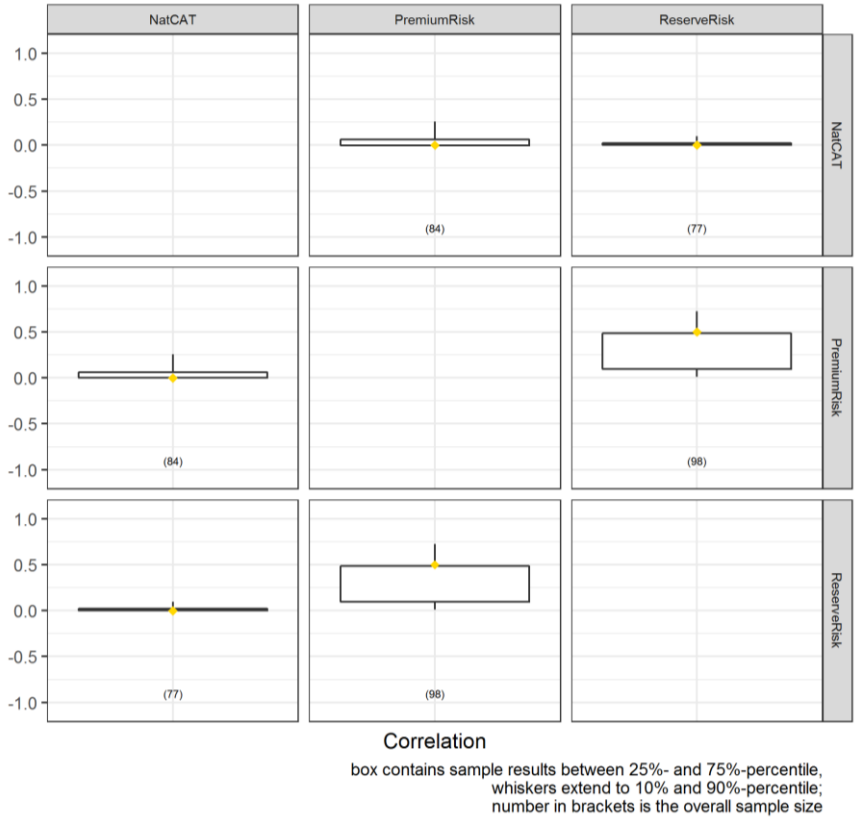

Figure 19 – Pearson correlation between Gross Non-Life sub-risks (2020)

A comparison using the Joint Quantile Exceedance probability shows similar results and a comparison is also made with the independence JQE (red diamond).

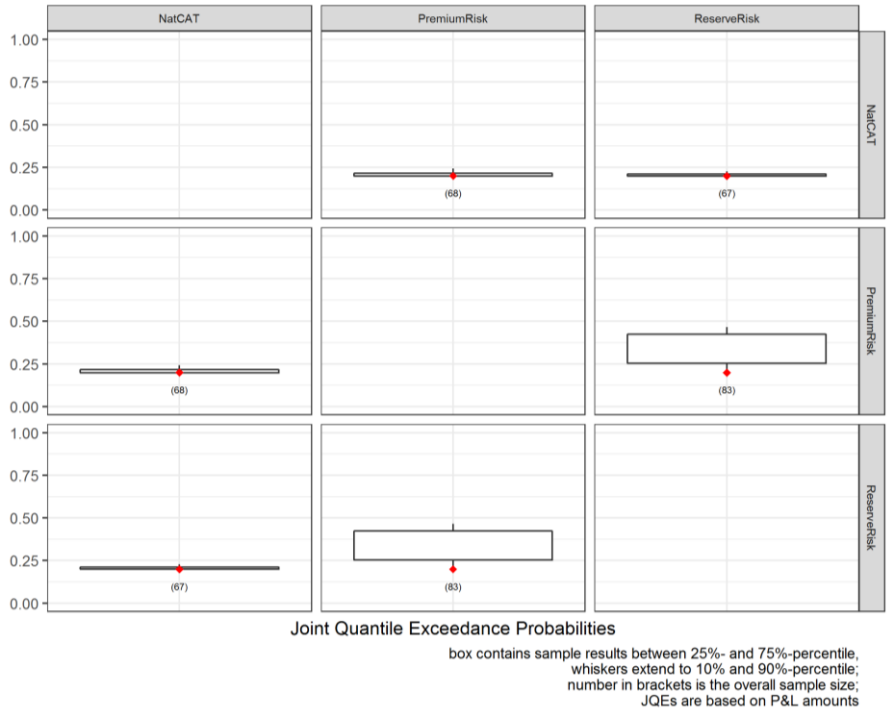

Figure 20 – Joint Quantile Exceedances between Gross Non-Life sub-risks (2020)

A comparison across time can be performed to gain insight in the model drift on dependencies between sub-risks. It is shown that boxplots in this case are very tight implying that correlations are stable across time and that no model drift occurred.

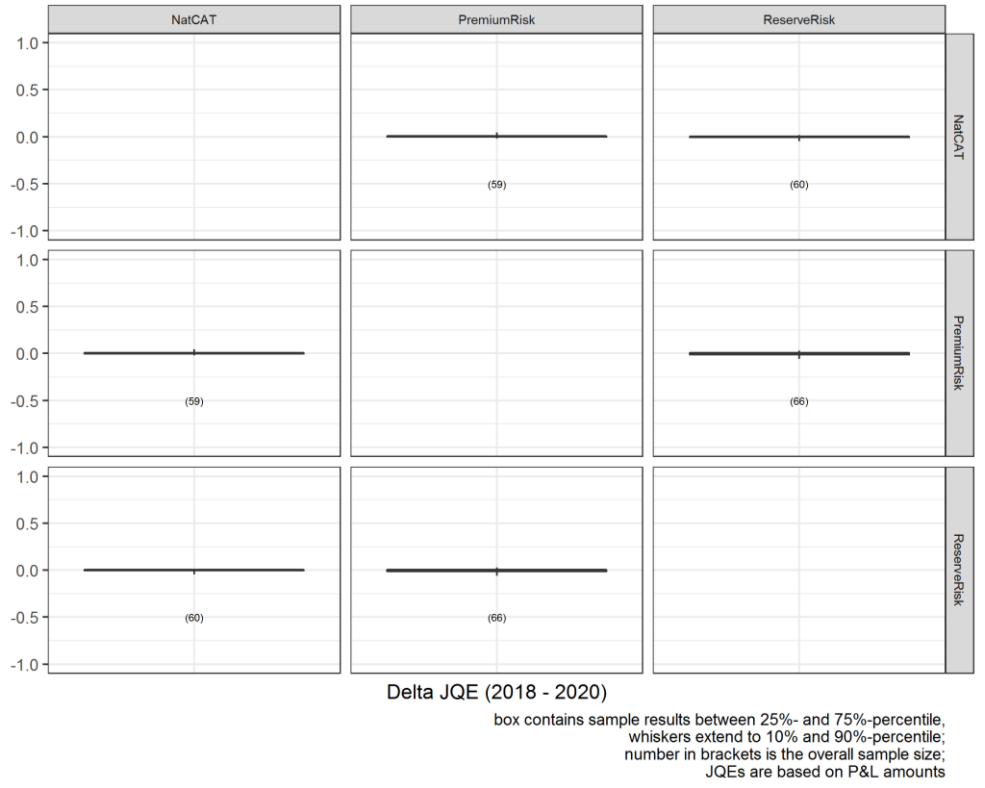

Figure 21 – Time Series of Joint Quantile Exceedances between Net Non-Life sub-risks (Delta 2018-2020)

A second analysis compares P&Ls of lines of business within reserve risk for the 5 focus S2LoBs (C&S, GTPL, OtherM, MTPL and FIRE).

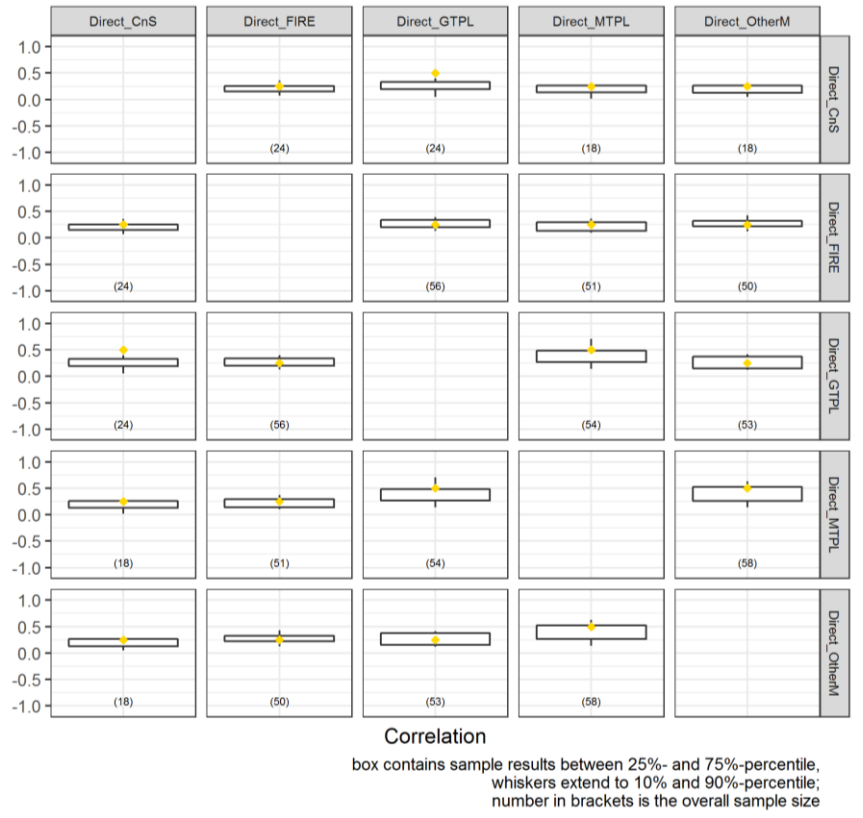

Figure 22 – Pearson correlation between LoBs within Gross Reserve Risk (2020)

This comparison mostly shows that correlations between MTPL and OtherM or between MTPL and GTPL are more dispersed. A deeper analysis shows indeed that some GTPL products are influenced by bodily injuries claims as is the case for MTPL. However, other GTPL products are driven by other types of claims and are therefore less correlated with MTPL. The dispersion of the correlation is therefore linked to the type of GTPL product offered. Furthermore, in some jurisdictions, MTPL and OtherM are sold jointly while in others they are sold separately. This difference in product mix can explain the dispersion shown. In most cases, the correlations are also higher than in the standard formula.

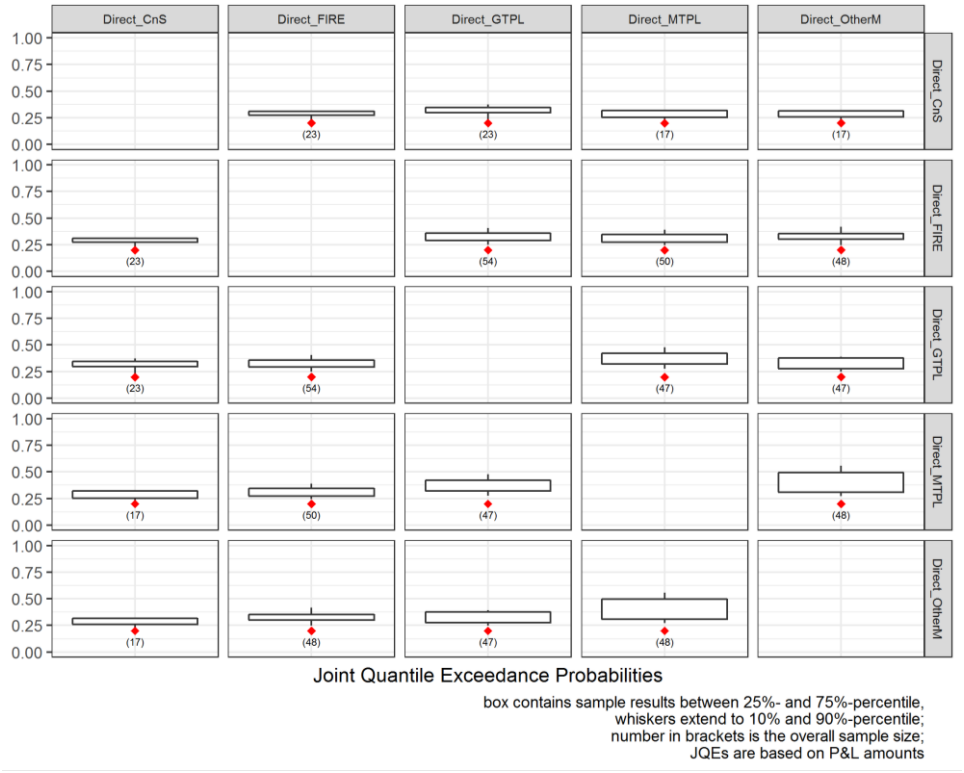

Figure 23 – Joint Quantile Exceedances between loBs within Gross Reserve risk (2020)

The analysis on JQEs shows similar results for the dispersion between MTPL and OtherM, while the dispersion for other correlations is more moderate.

Lastly, a comparison across time shows that also correlations between S2LoBs within reserve risk are very stable and no model drift is observed. Only a limited number of undertakings show a downward drift for correlations between FIRE and C&S.

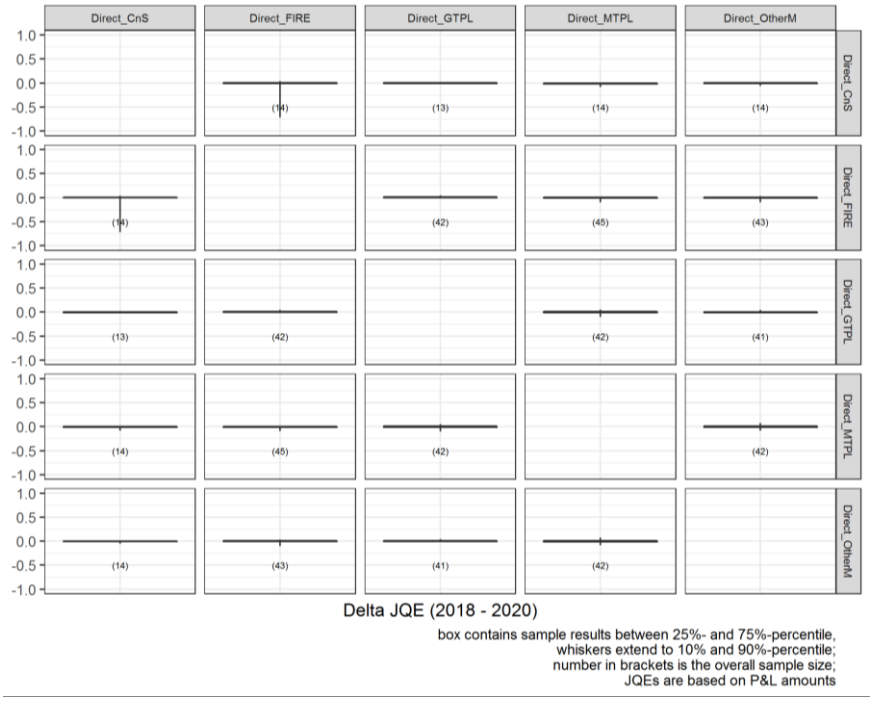

Figure 24 – Time Series of Joint Quantile Exceedances between LoBs within Gross Reserve risk (Delta 2018-2020)

A third analysis was performed on the lines of business within premium risk. Also in this case the scope was defined on the 5 focus S2LoBs (C&S, GTPL, OtherM, MTPL and FIRE).

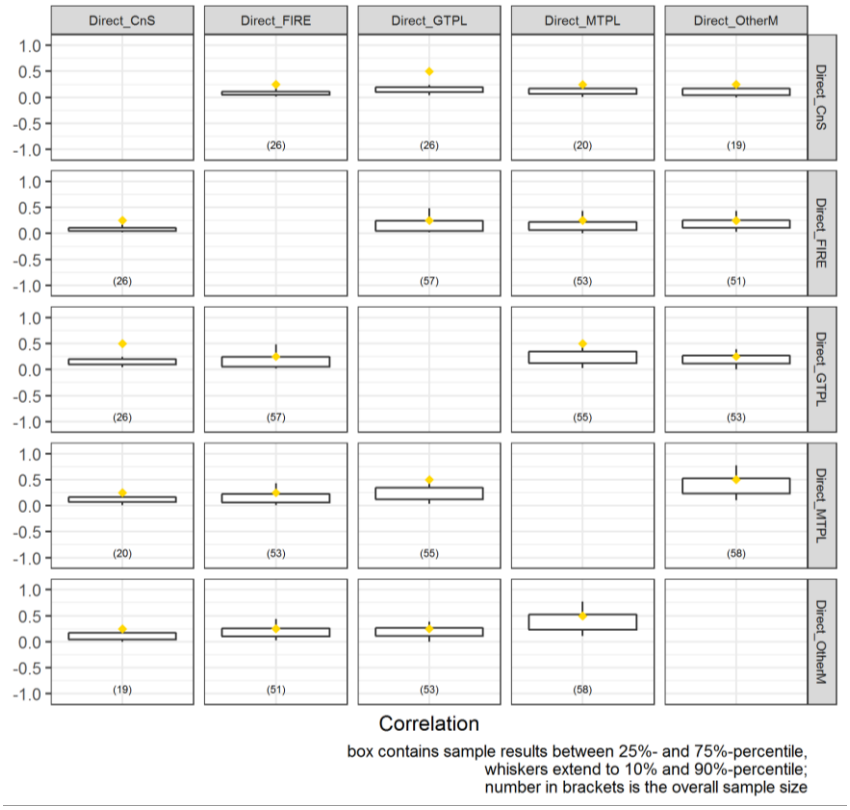

Figure 25 – Pearson correlation between LoBs within Gross Premium risk (2020)

As for the reserve risk, a first comparison, based on the Pearson correlation, is displayed in Figure 25 – Pearson correlation between LoBs within Gross Premium risk (2020)). Similarly to reserve risk, a higher dispersion is shown between MTPL and OtherM and a dispersion between MTPL and GTPL even though more moderate than for reserve risk. Also in this case the product mix is the main driver of the observed differences.

The analysis of JQEs shows similar dispersion for both these pairs of S2LoBs.

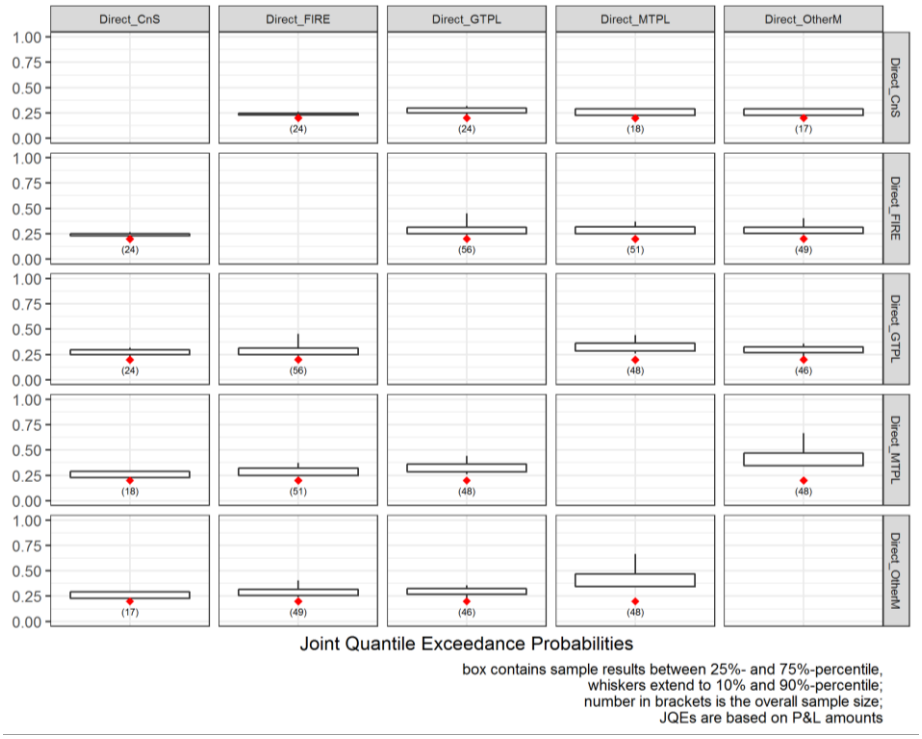

Figure 26 – Joint Quantile Exceedances between LoBs within Gross Premium risk (2020)

Lastly, the comparison across time shows that also for the dependencies between S2LoBs within reserve risk a stability is observed, and no model drift is observed.

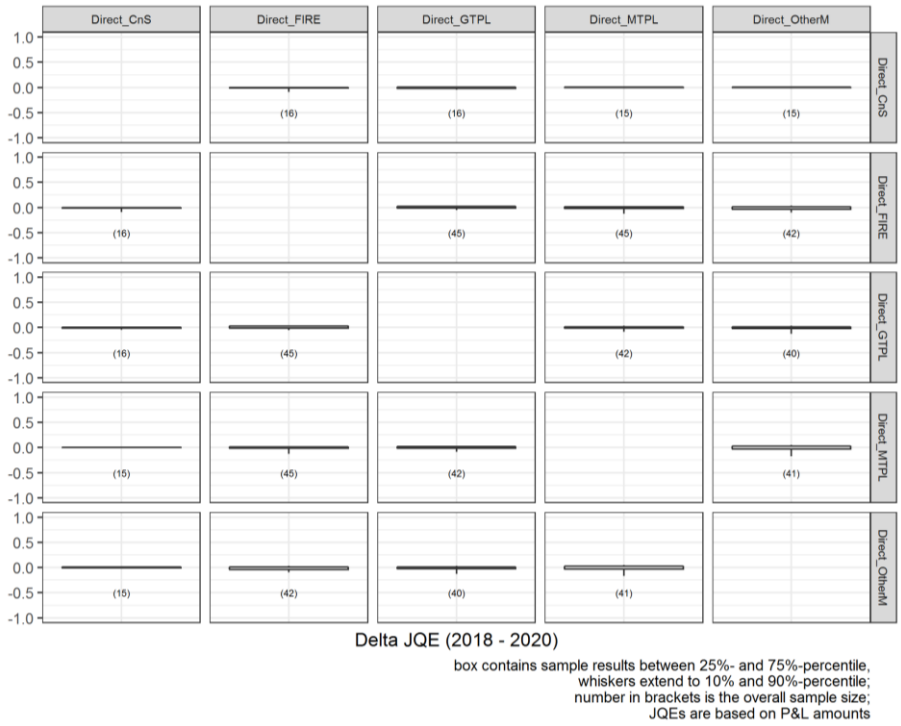

Figure 27 - Time Series of Joint Quantile Exceedances between LoBs within Gross Premium risk (Delta 2018-2020)

CONCLUSION AND FOLLOW-UP

Internal models incorporate diversification benefits between risks (e.g. market risk vs. non-life), between sub-risks (e.g. premium vs. reserve risk) and between lines of business (e.g. premium risk FIRE vs. MTPL).

The NLCS focuses on the analysis of diversification between non-life sub-risks and S2LoBs. The diversification of non-life underwriting risk with other risks is covered by the DivPG.

Within NLCS, an analysis on the diversification benefits has been performed at different diversification levels and included:

- Comparison across peers (with similar risk profiles);
- Across time (over several years) to assure that there is no model drift;
- Comparison against the Standard Formula diversification.

This was based on metrics focusing on “average” and on tail dependencies (more relevant for SCR calculations). Geographical diversification was not in scope of the analysis.

For the diversification between premium risk and reserve risk a high dispersion was observed across undertakings and in general higher diversification benefits compared with the standard formula.

Within premium risk it is observed that diversification between S2LoBs is also higher compared to standard formula.

However, diversification benefits remain stable across time in most cases indicating that there is no model drift for diversification.

The NLCS study comes to the conclusion that at a sector-wide level differences exist between SCR due diversification benefits. These are mainly observed between premium risk and reserve risk as well as between some S2LoBs within premium risk. Individual outliers have been identified. Follow-up is foreseen by the individual NCAs for these attention points per undertaking.

Findings on the risk level diversification have also been defined by the DivPG. Also in this case will attention point be followed up by the responsible NCAs.

7. DRILLING DOWN – S2LOBS AND INTLOBS

The aim of this chapter is to presents results and commonalities for business relevant granularities. For this purpose, certain facets of premium risk and reserve risk were analysed for the dedicated focus S2LoBs. Internal model modules for non-life underwriting risk show low levels of standardisation compared to other risk categories. Therefore, the following sections will drill down into S2LoBs in order to understand and evaluate fairly the developments of specific portfolios or aspects.

For the purpose of this report a selection was made on significant analysis, which provide value for this single standalone report. More analyses than the ones provided in this chapter were explored by the project group and will remain at supervisory disposal.

The project group used different peer group analysis to compare individual undertakings. These discussions started in the individual feedback sessions and will continue in national supervision of solo undertakings and groups.

7.1. GRANULARITY

SEGMENTATION

Internal models have to capture the risk profile better than the standard formula in order to provide value added to risk management in comparison to the standard approach. Therefore, undertakings are allowed to partition their businesses into homogeneous risk groups (HRG) in a manner they retain most sound for this purpose. The outcome of this segmentation is considered for the purpose of this study IntLoBs. By design they represent the undertakings' internal view of risk and are close to the parameterisation level.

For the purpose of a comparative study it is desirable to have access to the internal view of risk in order to understand individual risk aspects and have meaningful discussions on relevant business development. Actual comparisons require, however, also a reference point and intermediate granularities independent of the chosen modelling granularity.

For these two purposes the study introduced the concept of the S2LoB. Undertakings reported on the one hand on S2LoB granularity and mapped all IntLoBs to the most appropriate S2LoB in order to build reasonable peer groups for both granularities. The vast majority of undertakings were able to easily map the IntLoBs. For the few undertakings which struggled with this simple allocation, additional guidance was provided in the log files or by the project group.

NUMBER OF INTLOBS

Figure 28 displays the observed number of IntLoBs for each S2LoB for premium risk and reserve risk. This number is a first measure for the segmentation of portfolios from an internal view of risk perspective. For premium and reserve risk, on average, the number of IntLoBs is the highest for FIRE LoBs. Within these two risk modules the GTPL segment follows, although some undertakings show the highest number of IntLoBs mapped to this S2LoB. MTPL, OtherM and C&S follow.

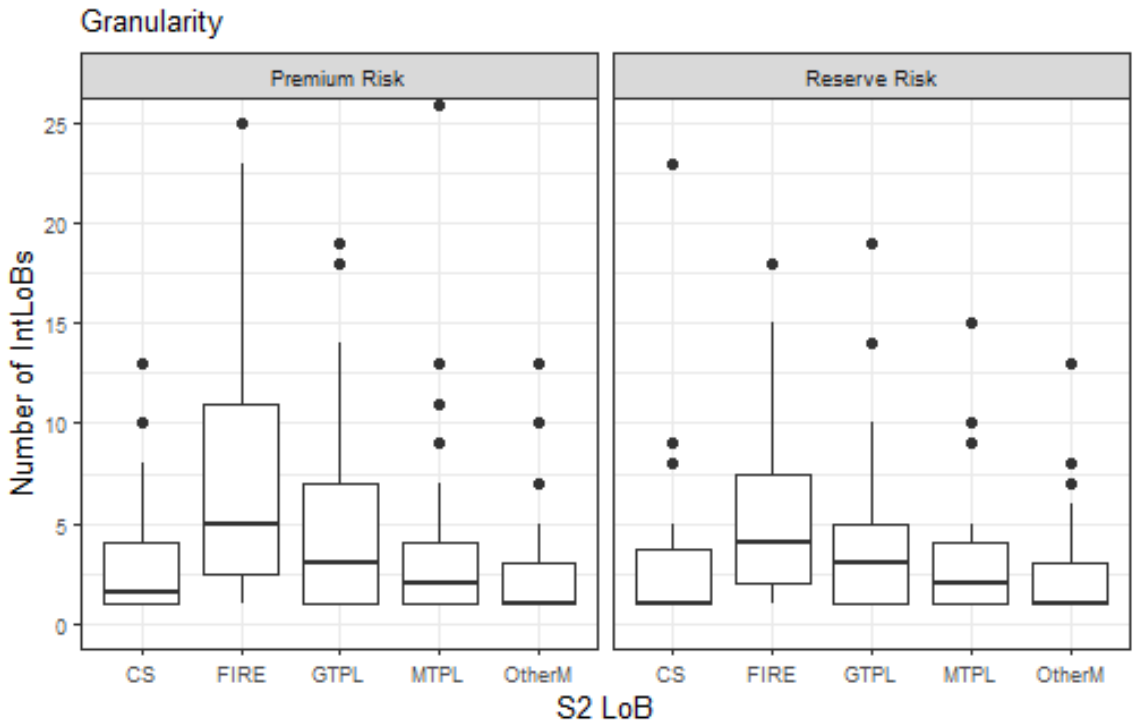

Figure 28 – Distribution of IntLoBs number per S2LoB

Three undertakings reported only one IntLoB for both premium and reserve risk. Of these three companies, only two restrict their business to one line of business. Another nine companies reported between 2 and 5 IntLoBs, of which five are C&S insurers or reinsurers. From the C&S report it is clear that finer granularities for C&S are available and need to be reported for the IM QRTs.

Insurance and reinsurance undertakings shall ensure that the design of the internal model is aligned with their activities as the model reflects the nature, scale and complexity of the business[11]. In the case of only one IntLoB per S2LoB, the results of the internal model should be compared to the

[11] Article 224 of the Delegated Acts.

standard formula and it should be assessed whether the internal model is a fit for the risk profile of the undertaking or if a undertaking specific parameter may be a better choice.

AVERAGE SIZE OF INTLOBS

In a second step the size of the IntLoBs was compared per S2LoB. Surprisingly, no substantial relationship between S2LoB size and IntLoB number was observable. This is surprising as the statistical a priori expectation would assume that the higher the exposure of the S2LoB, the higher the number of IntLoBs would become in order to build HRGs.

This observation is an indication that the number of IntLoBs in internal models is not mainly driven by pure statistic necessity but by other categorical information. Some of these categories are analysed in this chapter.

CONCLUSION AND FOLLOW-UP

During individual feedback sessions low granularities were discussed and highlighted with affected undertakings in conjunction with the other topics analysed during drill down analysis.

Where relevant, lack of granularity will be part of NCAs follow-up and undertakings within the confines of the necessity of HRGs.

The project group expressed an expectation that outlier behaviour at S2LoB level should be linkable and explainable by risk profile of portfolios at IntLoB level. Where this is not the case additional supervisory activity will follow by local supervisory teams and NCAs.

Furthermore, there seems to be space for improvement on meaningful granularities for a number of undertakings.

7.2. CAPITAL INTENSITY

The following chapter focus on the analysis of capital intensity at granularity of S2LoB and IntLoB in order to understand the risk profile of the sample.

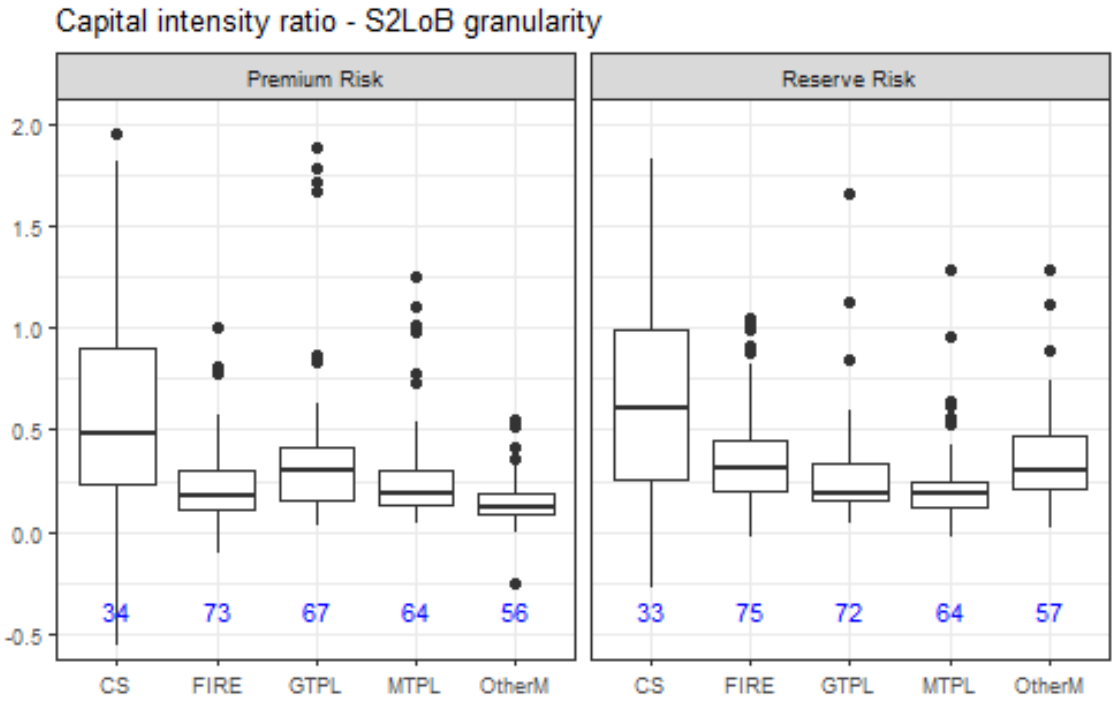

Figure 29 displays the distributions of the capital intensities for premium risk and reserve risk in reporting year 2020. The displayed data is net of reinsurance. The graph evidences that capital intensities can a priori be expected from certain granularities and types of business, even though the realisations show a significant dispersion and overlap. In general, IntLoBs show higher levels of dispersion than S2LoBs. The differences can be linked to specific portfolio behaviour. At the same time does this difference to the S2Lob specific capital intensities in the graphs also displays the differences due to diversification between S2LoB granularities and the IntLoB granularities, which are mapped to S2LoBs.

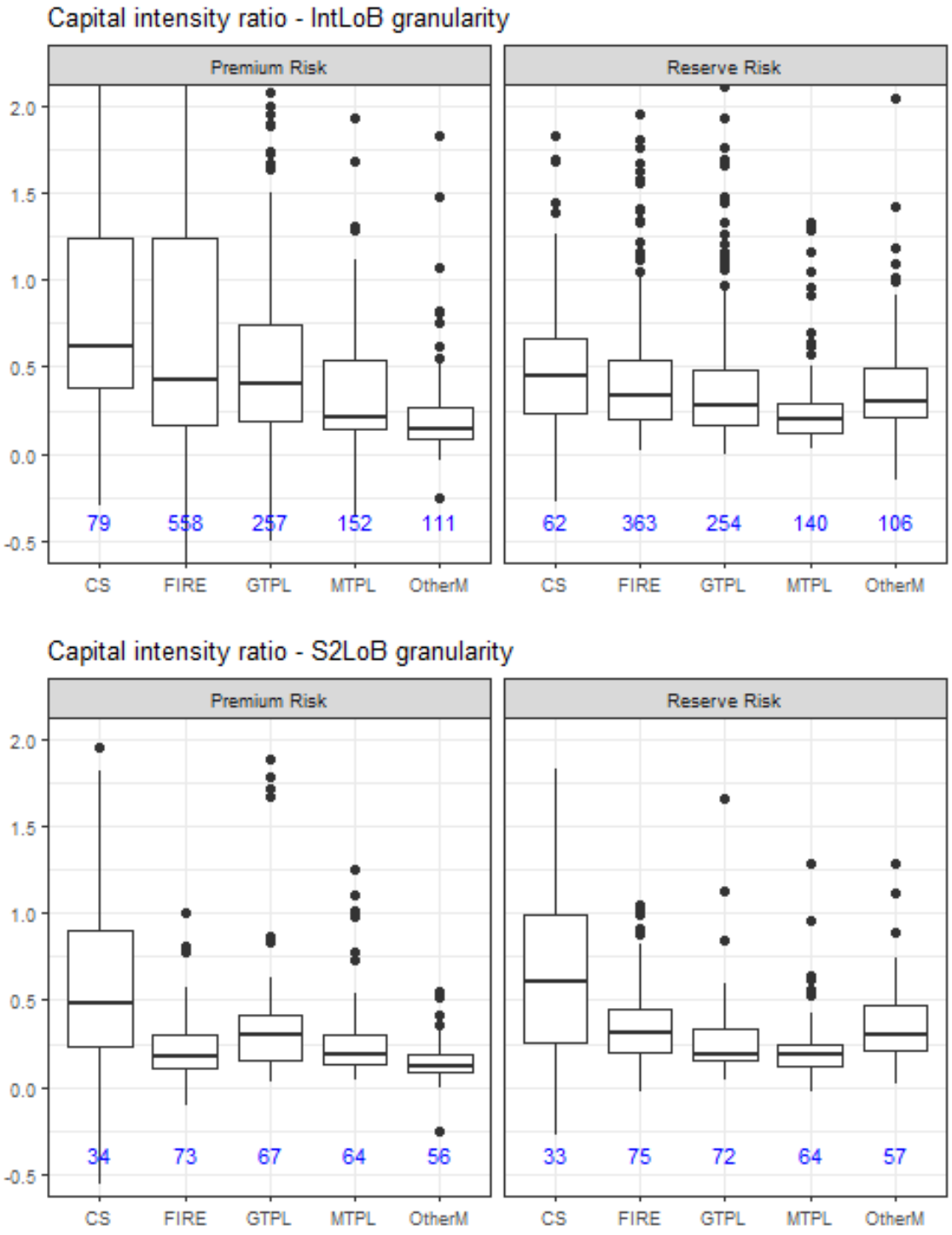

Figure 29 – Capital intensities net of reinsurance for premium and reserve risk by S2LoB and IntLoB

7.3. BUSINESS MIX

The more detailed the analysis drills down into the modelling level, the more apparent the specific type of business included in a portfolio becomes. Therefore, a number of additional qualitative peer-group information was collected for IntLoBs of the focus analysis in order to provide perspective on the analysed portfolios. Some of these peer group analyses were more successful than others.

In this section, two examples are provided. The first analysis is the benchmarking of FIRE business, which showed a remarkably robust outcome by peer groups, and GTPL, where the provided information was not of good enough quality and granularity to provide meaningful peer group analysis.

FIRE: PREMIUM RISK

Especially for premium risk, the FIRE LoB is split into a high number of internal lines of business. Within the survey, additional qualitative information on the predominant business type was requested. The reported business types were grouped into 7 main categories:

- Construction & Engineering
- Retail Costumer
- Individual Households
- Commercial Insurance
- Industrial Insurance
- Crop & Livestock
- Other & not applicable

The first 5 categories of the list dominate the FIRE business, covering around 94% of EP and 88% of BEL. An overview of the exposure for these categories, for direct business, is available in Table 5.

Business Type	EP	EP (%)	BE	BE (%)
Commercial Insurance	5.9 B	27%	4.2 B	28%
Construction & Engineering	1.4 B	7%	2.2 B	15%
Crop & Livestock	0.2 B	1%	0.1 B	1%
Individual Household	8.5 B	39%	2.6 B	18%
Industrial Insurance	3.0 B	14%	3.0 B	21%
Other & Not Applicable	1.2 B	6%	1.7 B	12%
Retail customers	1.6 B	7%	0.9 B	6%

Table 5 – Breakdown of direct FIRE business

The lines of business “Crop & Livestock” and the “Other & Not Applicable” categories have been excluded from the analysis. The same indicators as in the standard formula comparison (see chapter 6.3 for details), were computed.

The capital intensity, computed as described in chapter 6.3, differs substantially among the 5 analysed segments. The variability of the capital intensity increases when moving from Individual Household to more deep and complex risks. This is visible within the chart below.

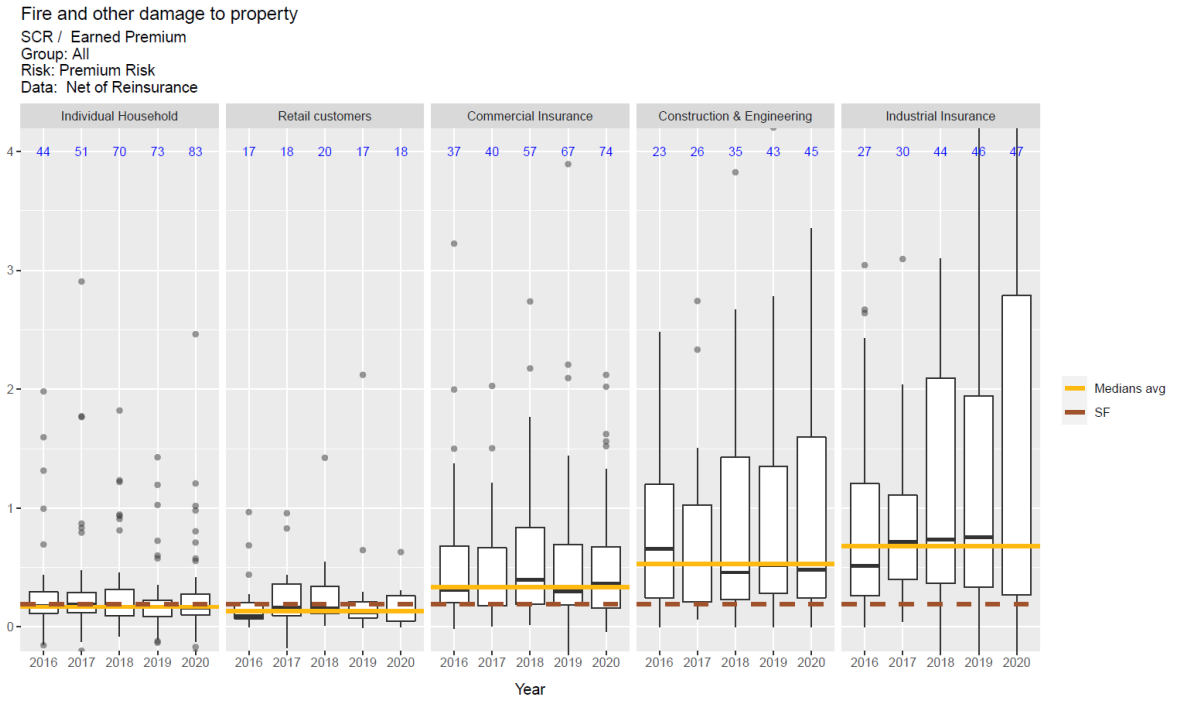

Figure 30 – Capital intensity break down of direct FIRE by IntLoB

MOTOR LINES (MTPL & OTHERM)

In comparison to other S2LoBs, motor policies are rather standardised products and a minimum third-party liability insurance cover in EU countries is specified by a Directive. Therefore, protection levels in the Member States are more similar than in other S2LoBs.

Furthermore, for most participants very low granularity levels were observed for motor lines of business. Therefore, there was little room for significant differentiations with respect to the concrete business mix. The project group observed that individual portfolio and business mix characteristics are currently mostly only determining factors for undertakings with business models involving niche and high-risk business. With respect to the explainability of results both motor lines lack clear categorisations. The only separating factor related to business mix used by a few undertakings is the distinction between private and commercial clients (e.g. fleets). In comparison, the split of the portfolio in different regions is more often applied. OtherM shows close to no inner granularity.

In the individual feedback sessions, the groups and related undertakings were asked to explain their portfolio composition so the project group can interpret the outcomes of the NLCS analysis in a meaningful way. However, this information was not always at hand of internal model owners and required on occasions significant turnaround times in the follow-up of the individual feedback sessions.

Since the understanding of the portfolio is key to model the risk profile adequate, for some undertakings the embedding of the internal model into the undertaking have to be strengthened in order to be able to justify expert judgment.

The project group encourages supervisors to expect more and better-quality information on the actual portfolios modelled.

There seems to be currently a mismatch between information used for pricing, planning and internal model calculation. The topic will be followed up where needed by NCAs. Neither age of driver brackets, no-claims classes, distribution channels, vehicle type etc. were used by a high enough number of participants as portfolio differentiators.

The project group obtained clear indication that besides the treatment of bodily injury claims the underwriting cycle in Member States dominates motor outcomes. Other common risk drivers for the whole sample have a minor relevance. At the same time, a high number of undertakings mentioned that understanding the business mix is crucial in order to understand the risk profile. While the project group agrees with this statement it is the undertakings' duty to provide this information.

GTPL

Business mix and portfolio effects can be anticipated in this S2LoB given that GTPL is a very heterogeneous class of business. This S2LoB and its IntLoBs exhibit a higher level of capital intensity dispersion. In particular, change in the business mix, in the view of risks or in the implied diversification benefit dynamics may be driven by the allowance for emerging risks (e.g. cyber) due to increasing underwritten exposures or their recognition thereof.

Based on the provided qualitative information, the project group attempted to categorise the IntLoB data in more homogeneous peer group portfolios of risks (e.g. retail, commercial, industrial) aimed to determine clustering effects. While initial analysis have shown some indications, the overall categorisation of portfolios on undertaking side was lacking an overall peer group behaviour. While the results are not conclusive enough to be presented in this report, they are, however, useful for local supervision by NCAs.

Due to feedback collected from individual feedback sessions, the observed lack of available information was mainly due to a lack of modelling or the availability to the teams filling the study template. This was a surprising observation to the NLCS since the proposed business differentiators were inspired by industry standards used for reinsurance placement. In some cases, this may imply a lack of communication between the teams modelling the placement of reinsurance (economic purpose) and modelling risk capital for supervisory purposes.

Similar observations were made for GTPL with respect to the treatment of bodily injury claims (B/I).

CONCLUSION AND FOLLOW-UP

While some analysis were successful and provided valuable insight, there seems to be space for improvement in the description and categorisation of business mix for internal models.

Teams modelling for internal model purposes must have the same information at their disposal as the teams working for commercial purposes, and it is the duty of the undertakings to provide meaningful portfolio information.

Where relevant, NCAs will continue conversations on the business mix on the focus S2LoBs analysed following the conclusion of this NLCS.

7.4. GEOGRAPHICAL FOOTPRINT

DEFINITION OF GEOGRAPHIES

The NLCS collected information on the geographical footprint of participating undertakings. This included information on the risk location as well as the contract location.

The analysis confirmed to the project group the a priori assumption that risk location (e.g. the actual location of property) tends to dominate the CAT risk modelling while the contract location (e.g. where the contract was underwritten) tends to dominate the modelling for premium risk and reserve risk.

It is worth mentioning that this subtle distinction is important to consider for communication within an organisation and across. For undertakings with high national market shares, the geographical footprint is moderate and the two definitions appear to be nearly identical or very similar in nature. For globally active reinsurers, industrial reinsurers or headquarters of multinational insurance groups, this approximation of the two views of location can be significantly at conflict when communicating results and making decisions.

Within the EEA cross-border business was considered for contract location as located in the Member State where the conduct supervisor would have been located for direct business. As displayed in Figure 31, the project group chose to focus on 4 main regions (Eastern, Mediterranean, Northern and Western Europe) within the EEA for analysis within this report in order to guarantee statistically relevant sample sizes.

Geographical footprint was discussed with affected undertakings and NCAs are followed up, were adequate.

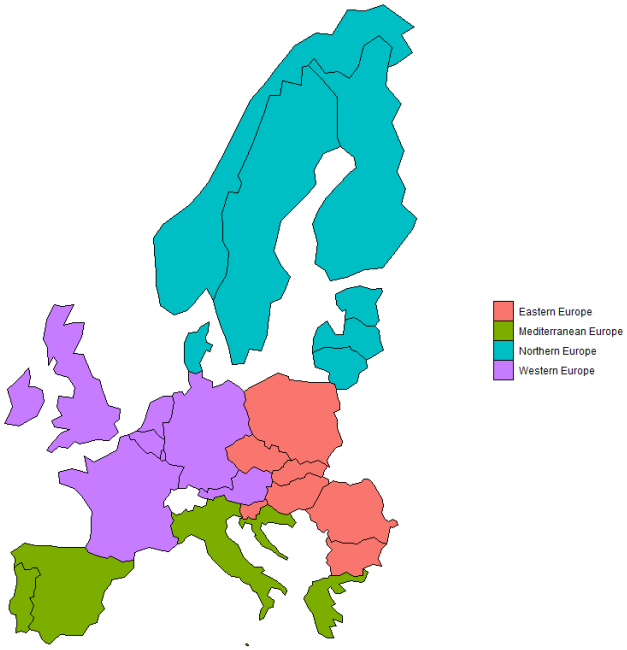

Figure 31 – Geographical main regions

EXAMPLE DISCUSSIONS

Motor lines IntLoB analysis for MTPL & OTHERM

Motor policies are rather standardised products and a minimum third-party liability insurance cover in EU countries is specified by a Directive. Therefore, protection levels per Member State are more similar than in other S2LoBs.

At the same time national markets still add national flavour to market developments and capital intensities tend to be relatively similar on national Level. This was verified by distinctive country specific clusters and still remain at the regional clusters. Furthermore, the materiality of bodily injury claims in MTPL in a country can influence the capital intensity.

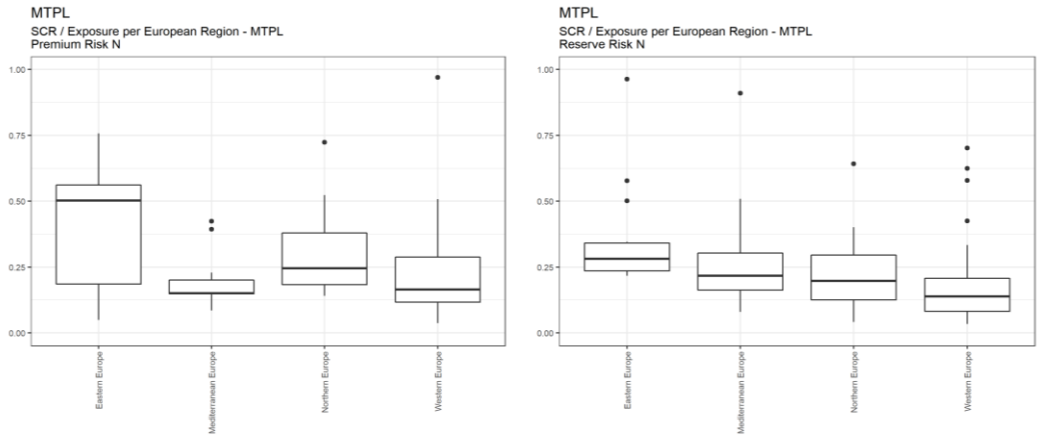

Figure 32 – MTPL capital intensity by region

On the one hand, the capital intensities in Eastern Europe for MTPL in Figure 32 tends to be much higher than in other regions. On the other hand, Western Europe has significantly low capital intensities. Since there are groups with subsidiaries in both regions, there is a strong indication that this outcome is driven by the claim data respective the calibration given the data and not the different model approaches which are similar within groups. The reasons for increased volatility can be legal environment for treatment of claims (e.g. bodily injury claims), structural breaks and composition or claim handling (e.g. frequency of case reserve adjustment).

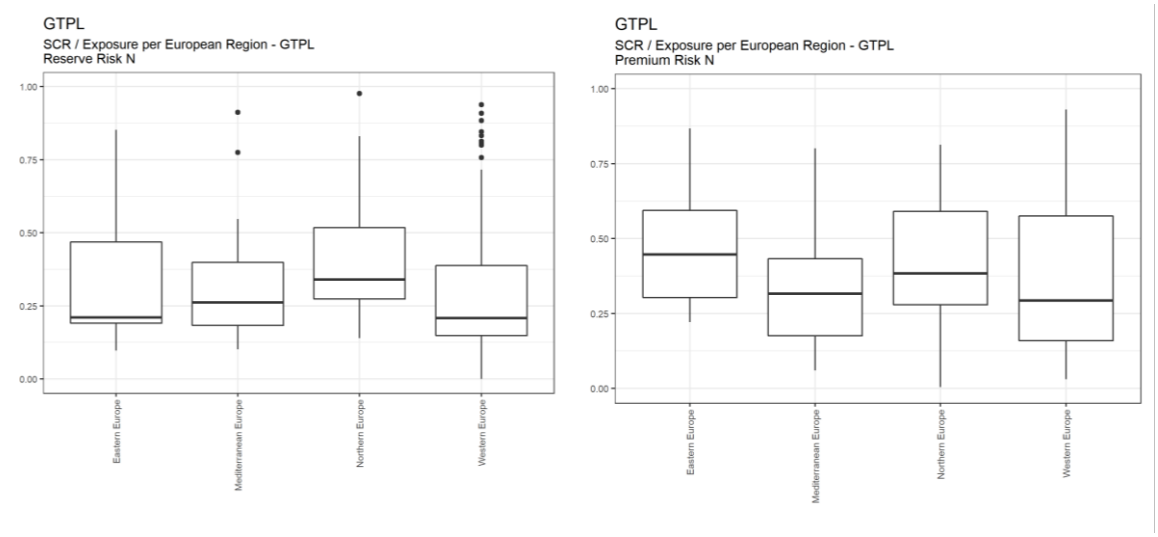

Figure 33 – GTPL capital intensity by region

7.5. TREATMENT OF BODILY INJURY CLAIMS

BACKGROUND

The first edition of the NLCS identified the treatment of bodily injury claims as key to the risk profile of both MTPL and GTPL. In comparison to other S2LoBs, MTPL policies are rather standardised products while the GTPL policies are not. Nevertheless, both S2LoBs can contain bodily injury claims and this section discusses their portfolios represented by IntLoBs under this perspective.

In general, the treatment and the inherent risk of bodily injury claims depends on the country where the policy is underwritten.

The study detected diverse treatment and behaviour for bodily injury claims. Differences mainly originate from:

- The perimeter definition of the respective IMs (e.g. group guidelines of handling of bodily injury claims)
- National specificities in claims handling and environment (conduct of business, local administrative law, etc.)
- Price levels/cost of living resulting in amounts of compensation

This results in different proportions of bodily injury claims in the overall results. As indicated above knowing the treatment of bodily injury claims and the respective annuities is key for supervisors in order to understand risk capital, capital intensity and its movement.

In this context the project group identified the following market and undertaking specific minimum characteristics for differentiation:

- Level of Compensation amounts (based on national laws etc.)
- Settlement and treatment of bodily injury claims in data
- Modelling approaches
- Risk category where the results are reported (i.e. within the LoB or as life underwriting risk outside the LoB).

As a consequence, results are differing

- Depending on the country the compensation can be based on the pure economic damage or additionally include costs of pain and suffering
- Bodily injury claims settled as lump sums generally lead to lower risk (capital) than annuities

- Allowance of indexation of claims especially for periodic payment orders (PPOs) in the UK can be a significant risk driver.

MODELLING

Depending on the compensation schemes and the settlement of the payment (esp. lump sum vs. annuity) the materiality of the bodily injury claims varies for each undertaking. Therefore, different approaches for modelling of annuity claims are used, which have been summarised in the list below:

1. No separate modelling (they are included in the claims triangle)
2. Stated in the claims triangle as a lump sum payment, in the development year when the claim is reported (no further treatment)
3. Stated in the claims triangle as a lump sum payment, but if settled as annuity it is treated separately
4. Dedicated lines for bodily injury claim and/or annuities
5. None of the above

Furthermore, the reporting of the risks stemming from annuities, which are often calculated with methods used for life underwriting risk, depends on the structure of the individual internal model. For instance, some undertakings aggregate it to the non-life underwriting risk and others report it separately in the life module.

For the purpose of analysis, four options were given for the categorization of IntLoBs as regards the treatment of bodily injury claims:

- Annuity
- Lump Sum
- Annuity & Lump Sum
- Other

The category “Other” includes mostly IntLoBs which cover solely property damages, do not differentiate between bodily injury claims and property damage (e.g. reinsurer) or the undertaking didn’t assign their business to one of other categories.

Most undertakings stated that Lump Sum is the prevailing method to treat bodily injury claims. Only for Eastern Europe the category Annuity & Lump Sum was predominant. Therefore, annuities have a higher significance compared to the other markets.

CAPITAL INTENSITY

The treatment and the inherent risk of bodily injury claims depends on the country where the policy is written. This is reflected in the results of the undertakings. Granularities seemed to have been predominantly driven by geography in either of the two S2LoBs.

The capital intensities for B/I Claims were analysed on IntLoB Level, because this was the most granular level available and the undertakings assign this IntLoB to a specific B/I treatment.

As mentioned in 7.3, the level of segmentation within MTPL is rather low and often the S2LoB is composed by only one underlying IntLoB. Therefore, there is often no distinction between property damage and bodily injury claims. In the following figures, the IntLoBs assigned to a category of B/I treatment represents only the predominant treatment.

Premium risk

Premium risk is typically modelled separately for attritional and large claims. In a further step, the two are aggregated into the distribution for an IntLoB. Depending on the reinsurance structure, especially large risks are often mitigated by non-proportional reinsurance[12].

For MTPL and GTPL the capital intensities for premium risk per B/I treatment categories are not very stable over time. Relying solely on these quantitative outputs is not sufficient and can lead to wrong conclusions. Reasons for these more volatile results are for example differences between direct and indirect business reflected in the sample and different risk measure definitions.

When analysing premium risk, a more qualitative approach would be necessary. Especially the share of B/I claims of the large losses gives an indication of the materiality. Also market events should be considered as ENID if your UT data is not sufficient. However, this individual assessment was not covered by the NLCS which has a more general focus.

Reserve risk

The capital intensities for MTPL by B/I treatment for reserve risk seem to be quite similar for the different categories. Therefore, solely analysing the categories is not sufficient. Taking into account the information of the different geographies and focusing on Europe (see chapter above) – where the assignment to the B/I categories in the regions was not evenly distributed – in regions with a higher share of ‘lump sum’ and ‘annuities’ in comparison to ‘lump sum’, a higher capital intensity is observed.

[12] The impact of proportional reinsurance on the capital intensities is rather low.

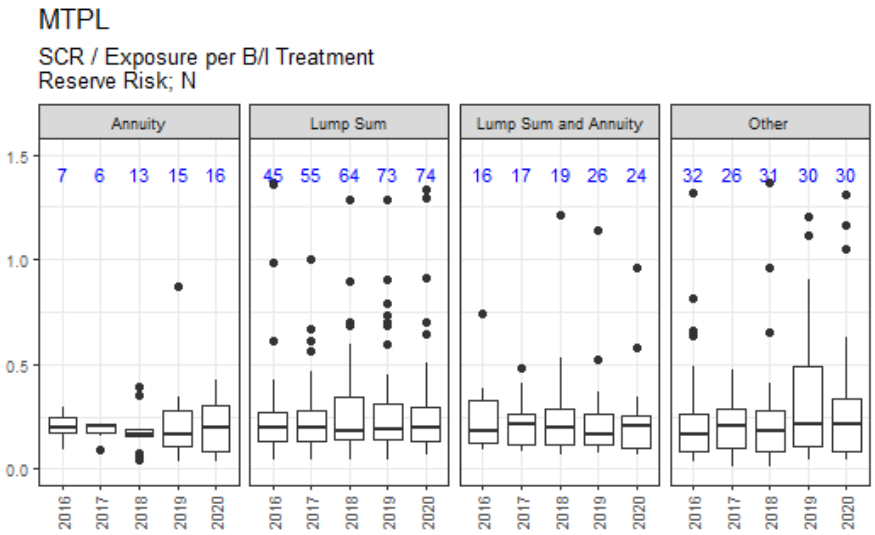

Figure 34 – MTPL reserve risk capital intensity by treatment of bodily injury treatment

7.6. TIME VALUE OF MONEY AND RISK EMERGENCE

In the insurance business, the realization of profits or losses often takes time due to the time lag between the payment of insurance policies and the settlement of claims. This emphasizes the critical importance of managing the time value of money, which is intricately connected to the emergence of risk. This section looks therefore into the duration (interest weighted average point of payment), the payments made within the first year and the relationship between them.

In general, Solvency II is based on a one-year time horizon, which means that it recognises only the risk of loss or adverse development, which can materialise within one year. One alternative time horizon, which is traditionally used, is the ultimate risk time horizon. This time horizon recognises risk as possible developments until undertakings have run off all their business.

In the graphs of this chapter only four of the five focus S2LoBs are shown. C&S was excluded given the particularity of this type of business, which usually gives the insurance undertaking unilateral cancelation rights. This is due to its general B2B character and is therefore more complex.

An eye-catching observation was made on the difference of risk emergence between premium risk (Figure 35) and reserve risk (Figure 36) for FIRE, GTPL, MTPL and Other Motor. The emergence of the ultimate risk was on average much lower and more concentrated for reserve risk than for premium risk.

This observation can be interpreted in the following way: internal model undertakings expect that for premium risk more uncertainty of results is realised in the first year than for reserve risk in proportion of the ultimate uncertainty.

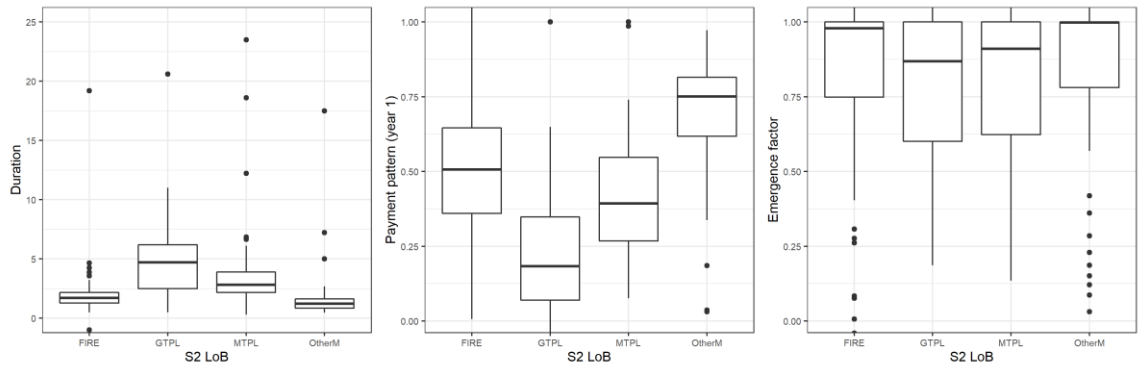

Figure 35 – Premium risk duration and timing of payment

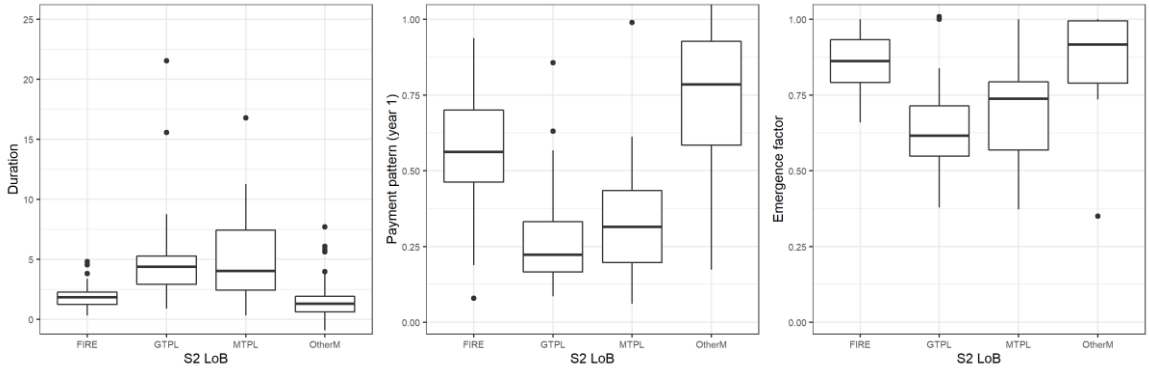

Figure 36 – Reserve risk duration and timing of payment

7.7. CREDIT AND SURETYSHIP WORK STRAIN

INTRODUCTION

The NLCS project identified the need for individual analysis on credit insurance (C&S) due to its complex and unique risk characteristics. Unlike other types of insurance, C&S involves evaluating creditworthiness of counterparties, each with their own distinct credit profiles. The risk exposure in credit insurance can furthermore be highly influenced by macroeconomic factors, industry trends, and individual borrower behaviours. Therefore, a comprehensive dedicated data request was developed to support targeted C&S analysis by a group of specialized experts on the topic from NCAs (from now on the "C&S work strain").

BACKGROUND

Trade is a driver of economic growth but is also accompanied with certain risks. A common transaction can result in the goods or services being delivered and only afterwards a payment will be received. This implies that a business active in international or domestic trade can be subject to counterparty risk on these trade receivables. However, undertakings can make use of trade finance to manage or mitigate these risks.

The Bank of International Settlements[13] estimates that 28% of world trade makes use of trade finance. This is evenly divided by between bank-intermediated trade finance on the one hand and trade credit insurance on the other hand.

Banks will in some cases act as a factoring institution. Sellers of goods and services will sell their receivables at a discount to a factor (typically a bank). The factor will typically be responsible for managing the debtor portfolio and collecting the payments related to the receivable.

Another financial product which allows to manage the credit risk of trade receivables is trade credit insurance. In this case, the trade credit insurer will reimburse non-payments due to a default and will manage the collection and recovery process after the default.

The C&S market in Europe has in total a premium income of 9,3 bn EUR in 2021. This market is characterized by a large concentration in a handful of players. The three main actors have about 44% of the total gross written premium for direct and proportional C&S. However, during the COVID-19 crisis, it was also observed that the business can be sensitive to financial crises and can behave in a procyclical manner. To this end, the non-life comparative study investigated further in detail

[13] Boissay et al., Trade credit, trade finance, and the Covid-19 crisis (bis.org)

whether the SCR of this line of business were sufficient and whether a level playing field between the different (re)insurance undertakings was guaranteed.

To this end, a number of analyses was performed on selected insurance companies for which C&S is relevant. These can be classified in three categories:

- **General non-life comparative analyses:** C&S is a non-life Line of Business. To assure the consistency with other non-life LoBs similar comparative analyses were performed as for other LoBs. They are mainly based on comparing non-life metrics and can be found in the section 'top-down analysis'.
- **General trade finance comparative analyses:** Trade credit insurance is a product which has strong similarities with factoring business including the models (so called credit Value-at-Risk). Comparative analyses, inspired by benchmarking studies in factoring, were therefore performed. These analyses were mainly based on comparing credit risk metrics (e.g. Probability of Default, Loss-Given-Default, capital charges as a percentage of exposure (similar to risk weights) etc.). These analyses can be found in the section on 'Comparison of risk profiles and SCRs.
- **Specific trade credit insurance analyses:** In the end, trade credit insurance also has specificities which imply it is different from other non-life Lines of Business and from factoring. To this end, a deeper analysis was performed to assure that the capital charges are in line with the fundamentals and that observed capital requirements give rise to a level playing field when accounting for differences in risk profiles. These analyses can be found in the section 'Risk-profile corrected SCR comparison (Bottom-up analysis)'.

SCOPE

The scope of the C&S analyses was limited to the undertakings for which this insurance product was material, from the point of view of the undertaking or the C&S insurance sector as a whole. The following steps were applied to define the scope:

- Undertakings were selected using an absolute and relative proportionality threshold: According to the log file, the conditions were the following: The gross earned premium for C&S at YE19 represents at least 10% of the total gross earned premium at YE19 or the gross earned premium for C&S at YE19 is greater than 100 million of euro. Therefore, 14 undertakings, for which C&S is a significant part of their business mix, are considered in scope of this specific analysis.
- For these undertakings, the data request contained specific fields for C&S, aiming to capture the specificities of the model (e.g. probability of default) in addition to the data collected within the standard NLCS template (e.g. SCR of premium risk, combined ratio…)

- Consequently, the analysis performed shared commonalities (e.g. in terms of data and indicators) with the NLCS but has also its own areas of focus to take into account the specificities of C&S.

TOP-DOWN ANALYSIS

SCR/EP at aggregate level (PR+RR+CAT)

The capital intensity is the quotient between the total aggregate SCR (PR+RR+CAT) for C&S divided by its earned premiums (EP) and is the most relevant indicator of this top-down analysis. The following graphs can be obtained for direct and proportional reinsurance business, gross (grey boxplots) and net (white boxplots) of reinsurance:[14]

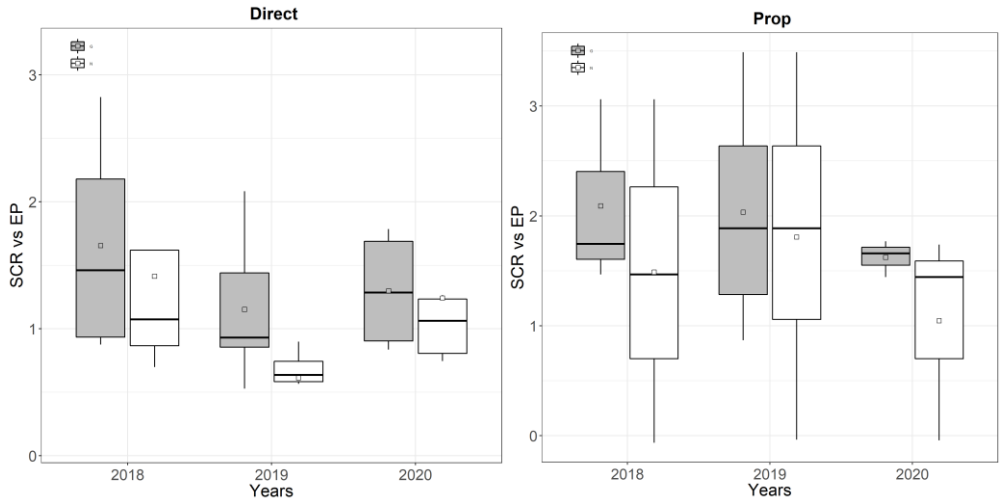

Figure 37 – SCR/EP at aggregate level (PR+RR+CAT) (grey: gross; white: net)

These ratios range from 0 to 3 for both direct and proportional businesses. The medians for direct business are around 1 but are close to 2 for proportional business. This means the capital intensity for the proportional line of business is higher, as it particularly can be seen in 2019 year where the proportional mean raises by at least 50% over the direct one for gross measures. This increase is bigger when considering net amounts.

In addition, it can be observed that the net values are lower than the gross values for direct business; for proportional reinsurance, the interquartile range of the net values are wider than those of the gross values but also wider than those of the direct business.

[14] For better comparability, direct business data (LoB 9) have been used without outliers, that is, outliers automatically identified by R taking into account the interquartile range (IQR) criterion.

Coefficient of variation of the premium risk distribution

The coefficient of variation, hereinafter CoV, was evaluated for each undertaking to measure the effect of reinsurance. This value is a relative measure of dispersion so it is independent of the unit in which the measurement has been taken, hence, it allows comparison among all undertakings.

The CoV is the ratio of standard deviation and the mean. It is useful because the standard deviation of data must always be understood in the context of the mean of the data: the greater the value of the ratio, the greater the dispersion of the values with respect to the mean.

To obtain comparable results, the entities whose means are close to zero were excluded from this analysis since their CoV cannot be computed or have infinite values.

The following graphs show the coefficient of variation of the Premium Risk distribution of C&S of the direct insurance and proportional reinsurance portfolio, where the grey boxplots represent gross of reinsurance coefficient of variation and white boxplots represent net of reinsurance coefficient of variation:

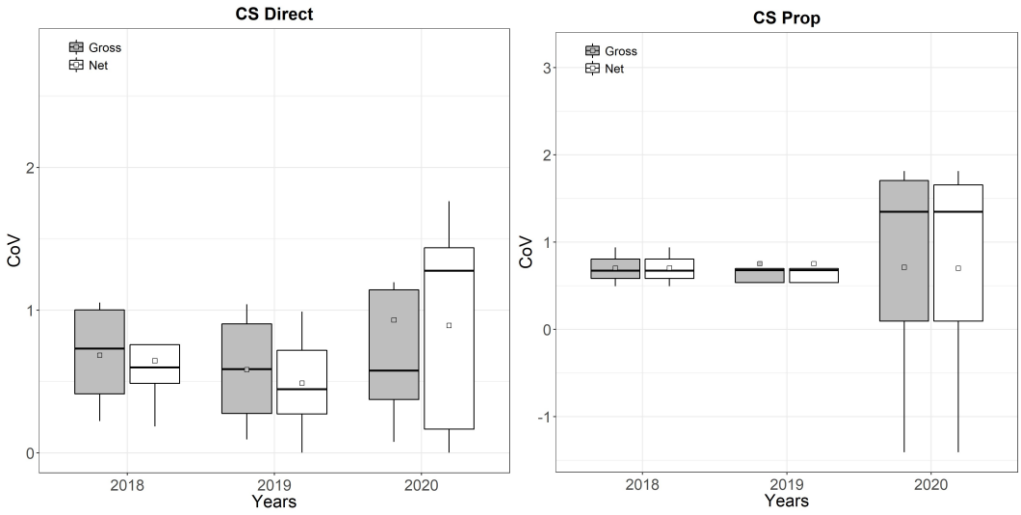

Figure 38 – Coefficient of variation of the premium risk distribution

In 2018 and 2019, the gross CoVs for direct business range from 0 to 1. However, the dispersion of the values increases in 2020 compared to previous years.

The effect of reinsurance in 2018-2019 can be observed, because the range of values are more concentrated. In 2020, the net values of the proportional reinsurance CoVs are more dispersed than in previous years; this dispersion is even wider than in the gross values of the year 2020.

On the other hand, there is no material impact of reinsurance on the premium risk distribution of proportional reinsurance since a significant number of the undertakings have presented the same value for both gross and net. The dispersion of the coefficient of variation is similar in the years

2018-2019, however, a significant difference can be observed in 2020, where the range of the ratios are higher.

P&L duration (YEARS) – Direct business

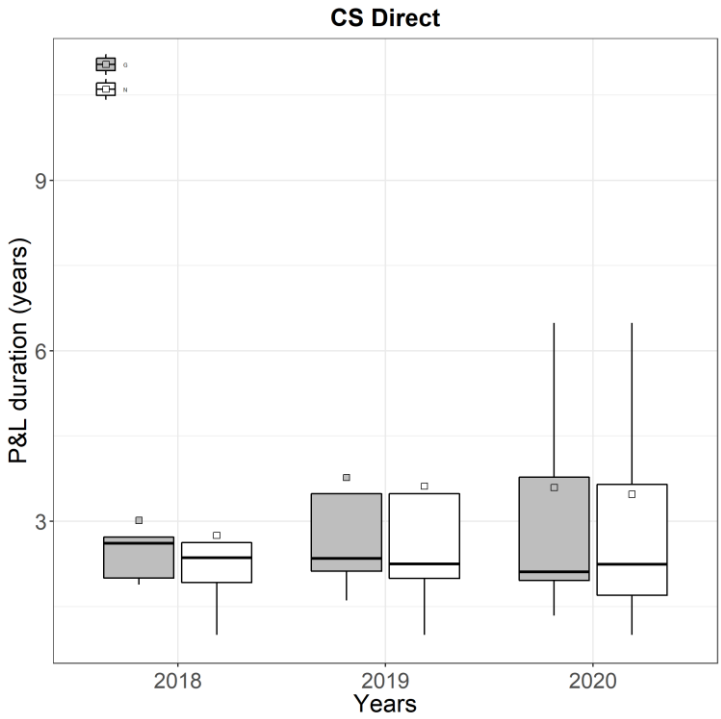

Figure 39 – P&L duration – Direct business (grey: gross; white: net)

The grey boxplots represent gross durations and the white boxplot represent net durations. It can be observed that the P&L durations oscillate between approximately 1 and 10 years. In addition, the amplitude of the range is greater in the years 2019 and 2020 than in the year 2018, however, the mean and median remain stable which means that the values within the boxplots are distributed in a similar way during the considered years.

The breadth of the range comes from the different characteristics of credit insurance and suretyship insurance. In fact, the time horizon of the suretyship is usually longer than credit insurance.

Finally, there is no material impact of reinsurance on the calculation of the P&L duration since a significant number of the entities have provided the same value for both gross and net durations.

P&L duration (YEARS) – Proportional reinsurance

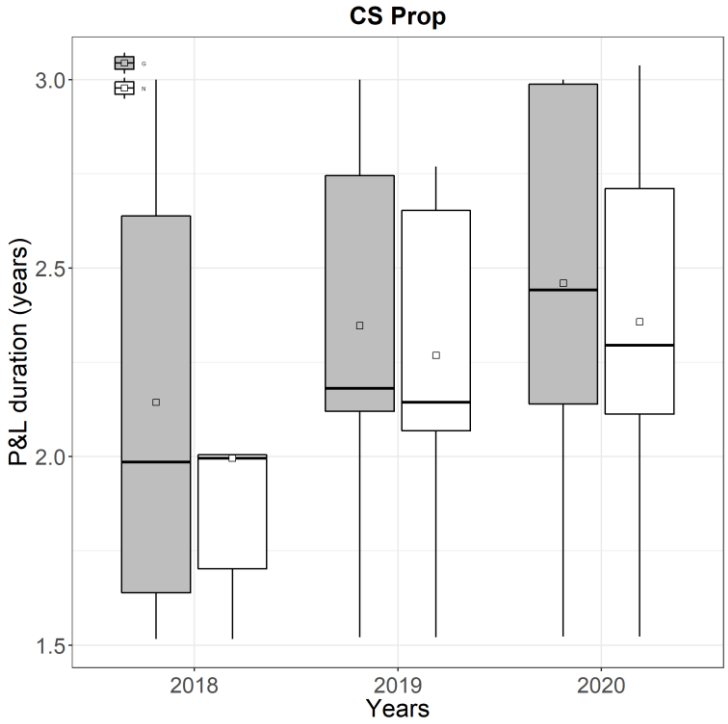

Figure 40 – P&L duration – Proportional reinsurance (grey : gross ; white : net)

The grey boxplots represent gross durations and the white boxplot represent net durations. When focusing on proportional reinsurance for C&S, it can be concluded that the values of the duration of P&L are concentrated between 1.5 and 3 years, with a different distribution of values within each year in scope of the data request, both gross and net.

The graph shows an increasing trend for the mean and median values, both in gross and net terms.

OTHER INSIGHTS ON THE MODELLING APPROACHES

Model class

According to the NLCS data, most of models are of "Credit VaR" while the other categories "Frequency-Severity", "Intensity" as well as "Other" represent a minority of models.

Model type	Number of undertakings
Credit VaR	8
Frequency Severity	2
Intensity based	1
Other	3

Table 6 – Model type within C&S sample

CAT modelling

Some qualitative questions focused on catastrophic risk, in particular the coverage of natural catastrophe (NatCat) and man-made catastrophe (MMCat), their modelling, as well as the treatment of economic recession as MMCat.

NatCat and MMCat are not modelled by the all undertakings and this will be followed up by national supervisory authorities. Credit insurers can manage dynamically their exposure during the life of the policy by increasing or reducing the exposure depending on economic performance of the buyer and/or the economic context.

The models are calibrated on historical data, aim to reflect the future management actions and the risks covered by the company in their policies; therefore the SCR reflects this behavioral response and as a consequence:

- It has been observed that trade credit insurers have reduced cover during recessions and times of crisis in the past. They have therefore fewer underwriting losses than would otherwise have been the case.
- If credit insurers were not to reduce cover in the event of a pending crisis, they might incur losses that they could find difficult to absorb.

COMPARISON OF RISK PROFILES AND SOLVENCY CAPITAL REQUIREMENTS

Geographical split

An overview of the exposure from the majority of direct credit insurers[15] in terms of credit limits per geographic area where the buyer or counterparty is located is shown in Figure 41Figure 41 – Geographical exposure of the majority of direct credit insurers by geographic area. These geographic areas are Austria, Belgium, France, Germany, Italy and Spain, reported therein as "EU 6", the other members of the EEA, reported therein as "Other EEA" and UK and the rest of the world, "UK and rest of the world". The exposure is mainly focused on "EU 6" area, representing more than half of the business and the two other areas have a residual share.

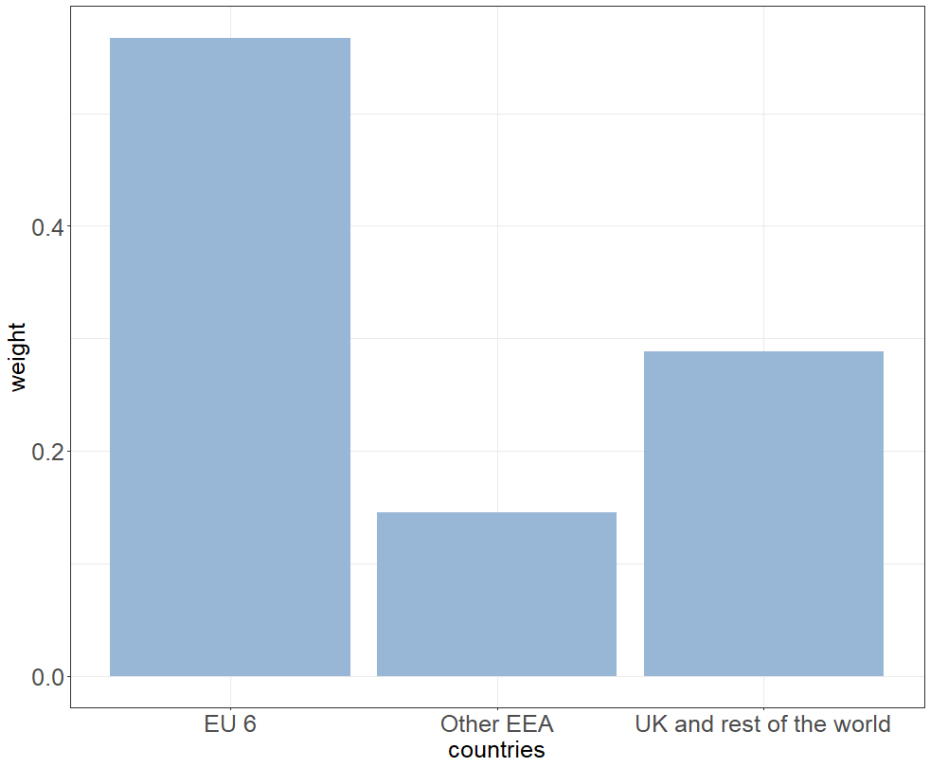

Figure 41 – Geographical exposure of the majority of direct credit insurers by geographic area

Exposure size

In a similar fashion, an analysis was performed on the split of exposures by tranches of size for the majority of direct credit insurers. The upper limit of each tranche can be seen in Figure 42Figure 42

[15] For other credit insurers, the quality of this specific data was often lacking to construct an overview of the exposure.

– Exposure class breakdown of the majority of direct credit insurers. This allows to have a view on concentration risk due to very large credit limits in the portfolio. Those undertakings are mostly focused on the intermediate segment (exposures between 1 million and 10 million of euro). If we aggregate the first 4 classes, so this means grouping the exposures up to 10 million of euro, then we see that the obtained class represents more than 75% of the total exposure. Some credit limits go beyond 150 million of euro, but this is rather exceptional as it concerns less than 5% of the total exposure.

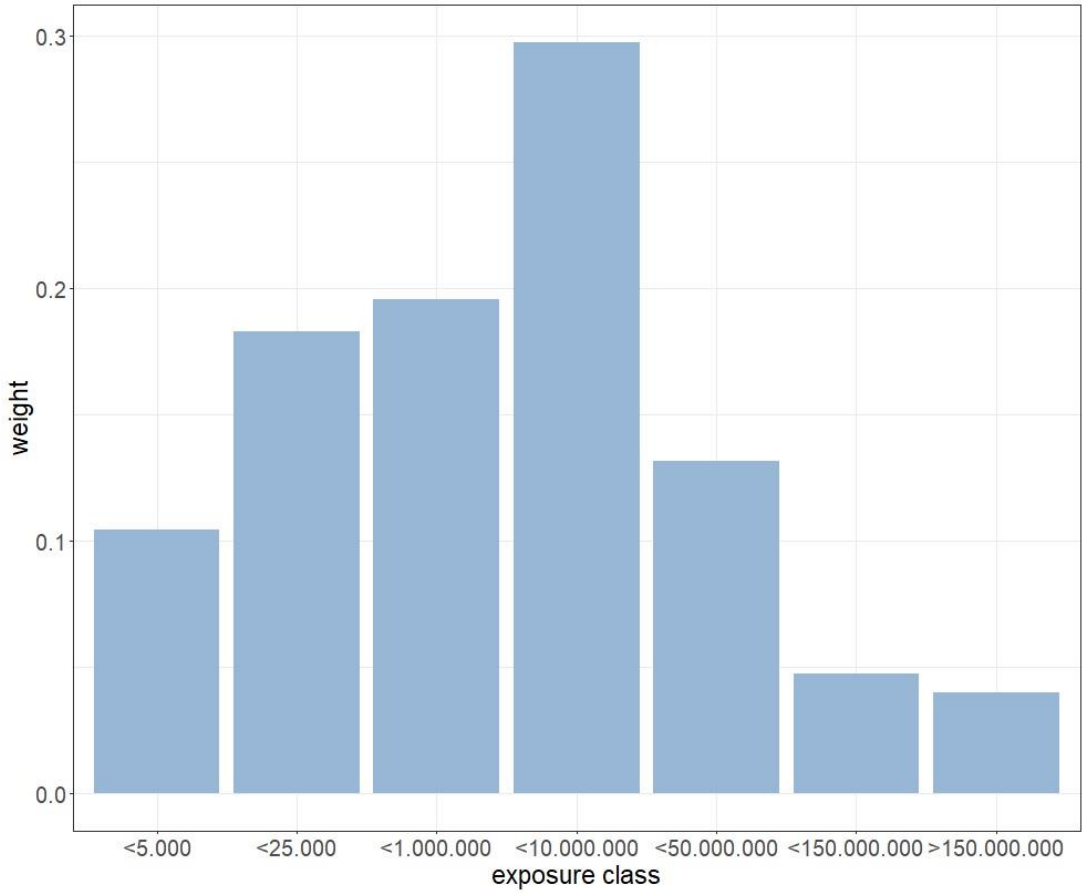

Figure 42 – Exposure class breakdown of the majority of direct credit insurers

Probability of Default

Moreover, a comparison was made of the **estimated probabilities of default** split per geographic areas for an extended majority of undertakings, which provided data. Note that, in this section, the mean and median are removed from the boxplot because of the small size of the sample under consideration. The underlying data of the graph consist of a mix of direct insurance and proportional

reinsurance. Differences between geographic areas can be observed. Both “EU 6” and “Other EEA” areas have a larger dispersion than the other geographic area. Those differences between areas can be explained by on the one hand underwriting elements like the credit quality and the economic sector where the buyers are active. On the other hand, macro-economic factors like economic growth play a role in the difference in probability of default.

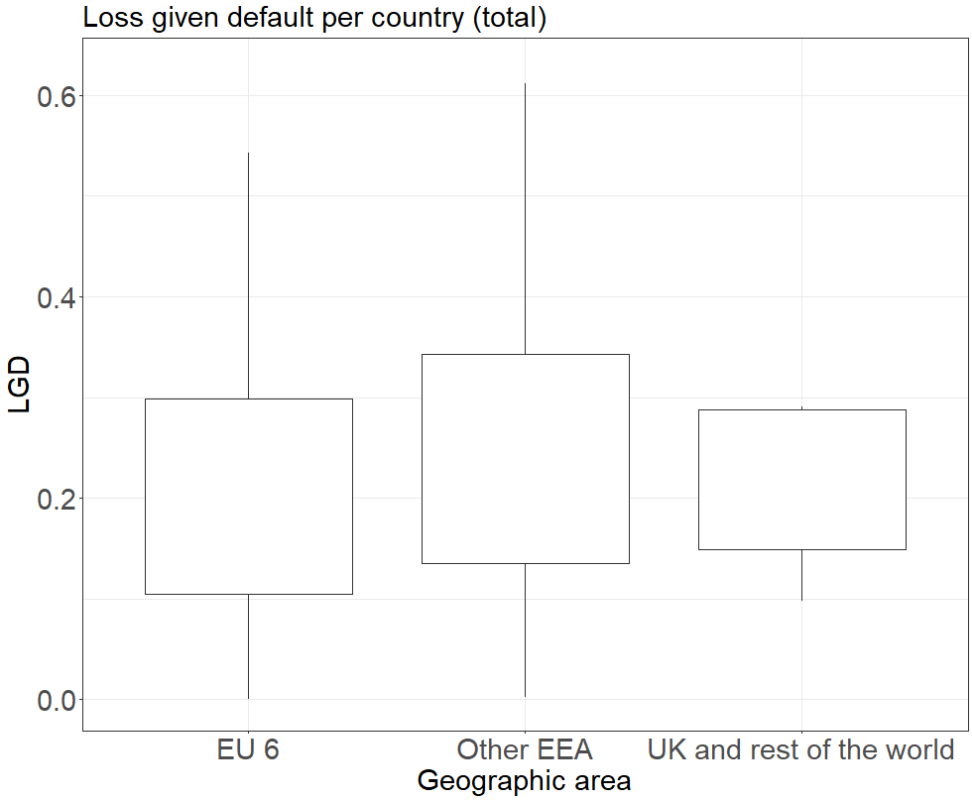

Figure 43 – Probability of default by geographic area

Loss-Given-Default

An analysis was also made for the **estimated loss given default** split per geographic area using the same sample as in the previous graph. As in the previous graph, both “EU 6” and “other EEA” areas have a larger dispersion. The differences between areas can be explained by the fact that the insolvency legislation is established at national level, and the recovery and recollection processes might differ between countries.

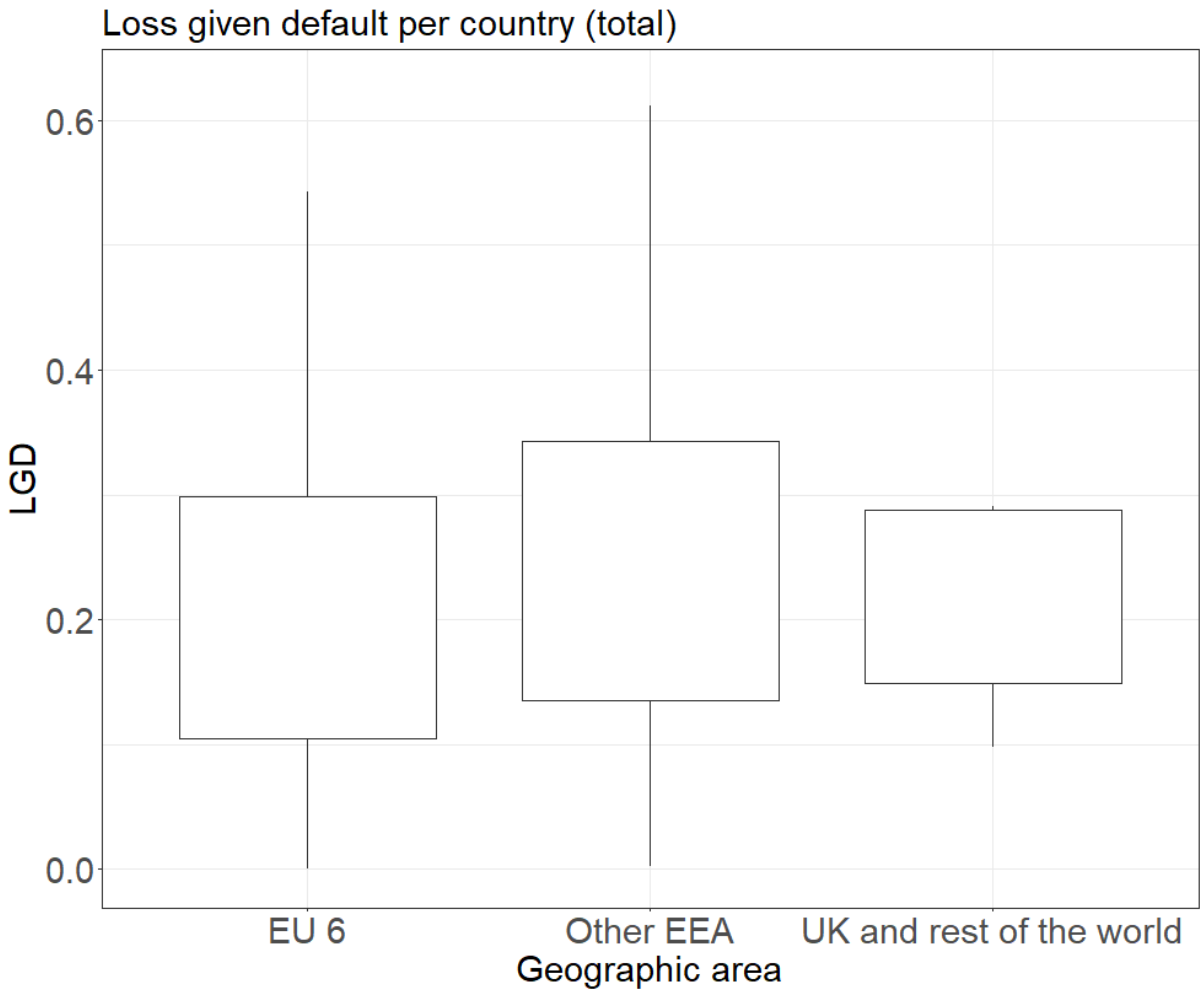

Figure 44 – Loss given default by geographic area

Large Risk indicator

Moreover, a ratio is introduced to measure the **concentration of large risks** in the total exposure. The sample of analysis is restricted to an extended majority of direct credit insurance undertakings. This large risk indicator is defined as the exposure above 10 million of euro as a percentage of the total exposure. The graph shows that countries of the "EU 6" area tend to have lower share of large risk but there are differences within the areas.

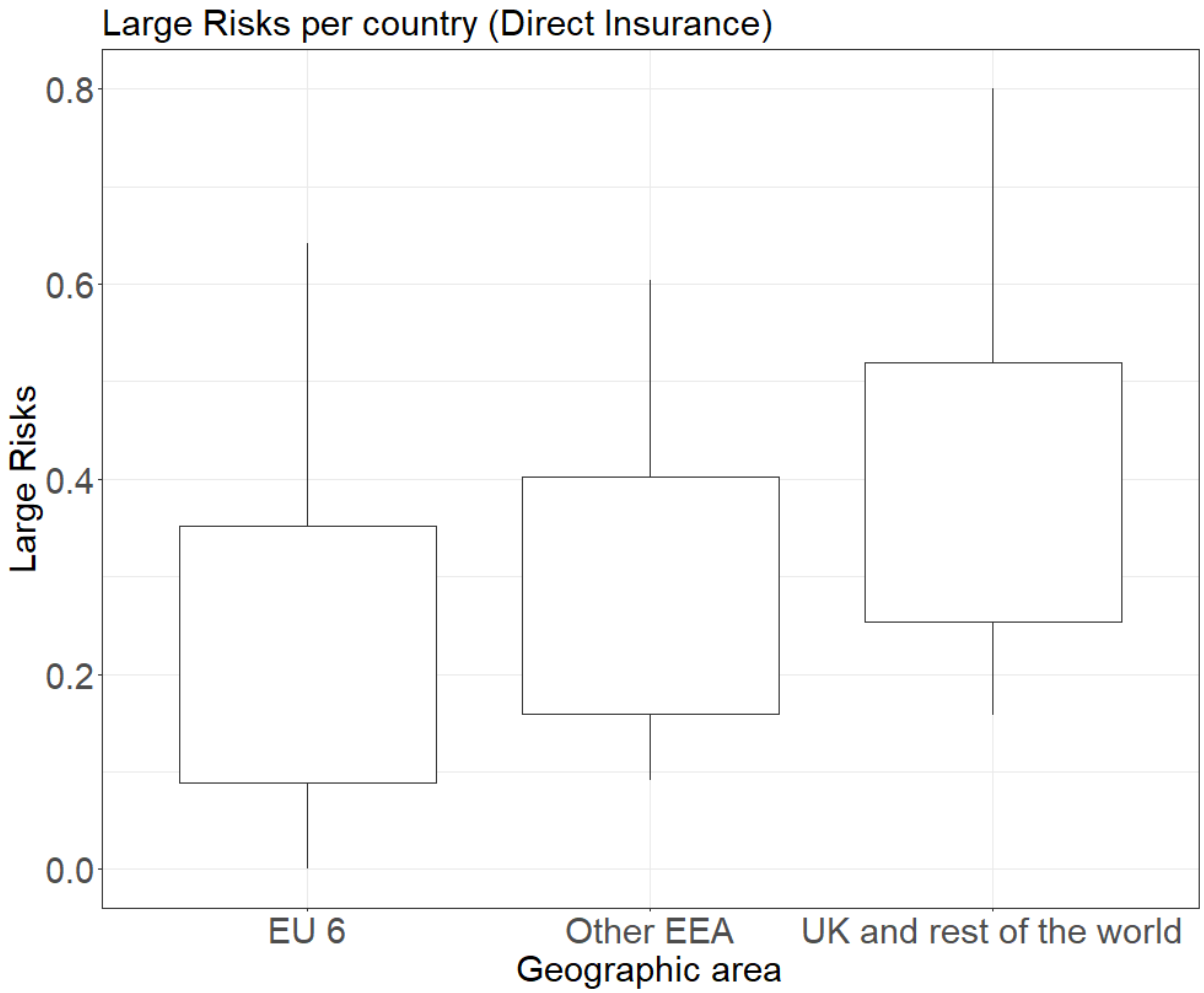

Figure 45 – Large risks by geographic area

Solvency Capital Requirements

Lastly, a comparison was made of the capital charges defined as the SCR as a percentage of the total exposure (capital intensity) per geographic area. This analysis is based on data reported by an extended majority of undertakings. The underlying data of the graph consist of a mix of direct insurance and proportional reinsurance. Also, in this case differences between areas can be observed. The differences can be explained by the elements presented above, such as exposure, probability of default, loss given default and large risk measure. Lastly, other elements, such as the economic sector in which the buyer is present, have an impact on the SCR.

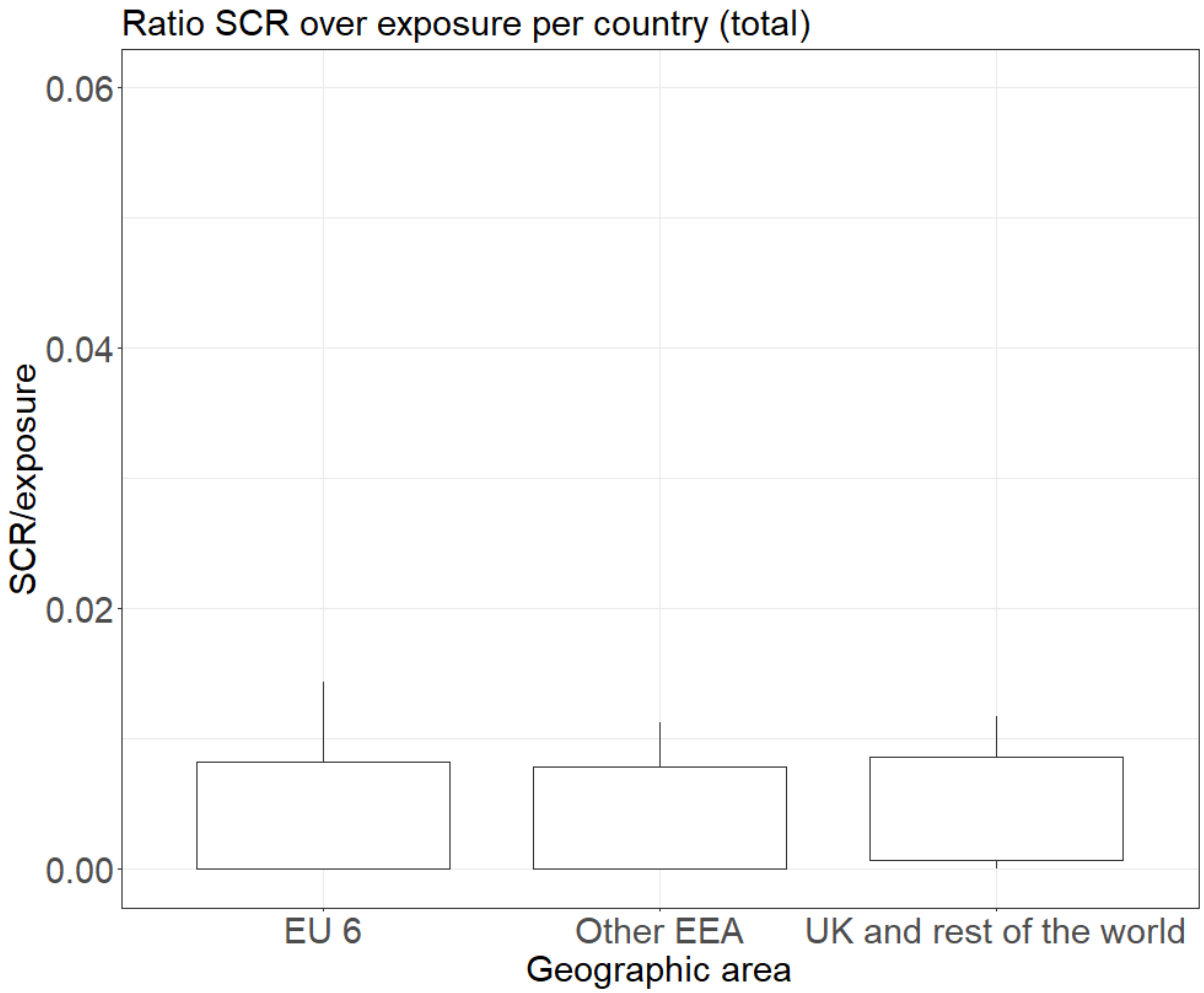

Figure 46 – Capital intensity by geographic area

RISK-PROFILE CORRECTED SCR COMPARISON (BOTTOM-UP)

The above comparisons show that differences can exist between capital charges and that they are often driven by differences in risk profiles. To this end, a deeper comparison was performed of the capital charges between undertakings, where the capital charges were corrected for differences in risk profile by means of statistical analyses. This allowed to compare an undertaking with the risk-profile corrected average of the market and to gain insight in the dispersion of capital charges in the European trade credit insurance sector. For the comparison between total exposure data and capital charges, 6 undertakings provided data of sufficient quality. For comparison with probability of default, loss given default and large risks, the analysis was based on the majority of direct credit insurers. Given the limited number of suretyship insurers, the analysis was not performed for this product.

In this context a comparison was made between the capital charges on the one hand and risk profile indicators on the other hand such as probability of default, loss-given-default, total exposure and the large risk indicator.

A bivariate comparison between the capital charges and the risk profile indicator is expected to show that capital charges are higher when the portfolio is small (exposure), risks are concentrated (large risks), credit quality is low (probability of default) and losses are high (loss given default).

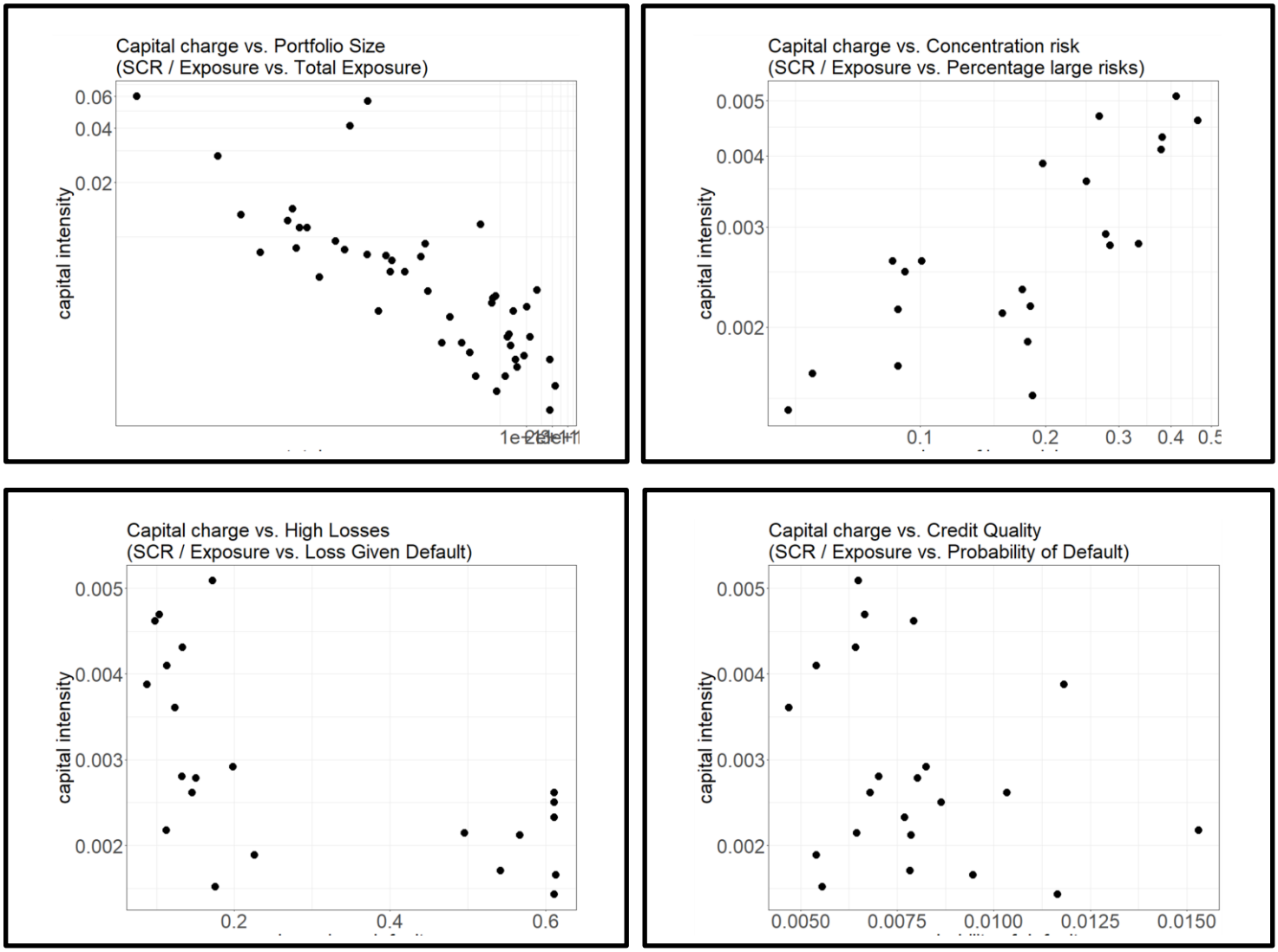

Figure 47 – Analysis of capital intensity relationships

The bivariate analysis shows, however, that this expected economic relationship only holds for portfolio size and concentration risk. For probability of default and loss given default, the influence on capital charges is not in line with expectations.

Based on this data, an additional multivariate analysis between capital charges and the four risk-profile indicators was performed. This allowed to reconstruct market-average, but also risk-profile adjusted SCRs for Trade Credit Insurance per country. The remaining differences are then purely driven by model uncertainty. At a total level a limited difference is observed between the highest and the lowest adjusted SCR after diversification.

CONCLUSION AND FOLLOW-UP

Summary

The following observations were derived from bottom-up and top-down comparisons of capital intensity for premium, reserve, and catastrophe risk:

- A top-down analysis shows different premium and reserve risk definitions exists. But at aggregate non-life level an SCR comparison is possible. Data of the majority of direct insurers shows limited differences among capital requirements.
- A bottom-up analysis shows that the differences in SCRs reflect to an extent differences in risk profiles and corrected SCRs for risk profile differences. As previously, data of the majority of direct insurers shows limited differences among capital requirements.

Capital intensity for catastrophe risk is influenced by the reduction in credit limits.

- Trade credit insurers have reduced cover during recessions and times of crisis in the past, thereby having fewer underwriting losses than would otherwise have been the case.
- As SCRs are based on historical data, they reflect this behavioural response and are lower in the event of reductions in cover. Therefore, if credit insurers were not to reduce cover in the event of a pending crisis, they might incur losses that they could find difficult to absorb.

A comparison of risk profiles has been performed using data on exposures, large risks, probability of default, loss given default and SCRs.

- Differences in risk profile translate into differences in capital requirements.

Follow-up

As mentioned above, the C&S work strain has analysed a limited set of undertakings, hence the conclusions and follow-up of this section concern only these undertakings.

Some basic data describing the business was not provided and/or provided with inconsistencies, therefore excluded from the analyses. Such issues have been discussed with participants during individual feedback sessions and will be accordingly followed up by relevant NCAs.

Moreover, it was observed that the solvency capital requirements for premium and reserve risk were comparable for the majority of direct credit insurers. However, detailed differences were observed for specific capital charges. NCAs will follow up these attention points with the undertakings in line with their criticalities.

8. TABLE OF FIGURES

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