

Prudential Regulation Authority

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23 January 2023

Dear [Chief Executive Officer]

Insurance Stress Test 2022 feedback

This letter contains the results of the PRA Insurance Stress Test 2022 (IST 2022) launched in May 2022. In total, 54 insurers took part (16 life insurers, 17 general insurers, and 21 Lloyd's syndicates). Life insurers were asked to assess their solvency position following an adverse economic scenario and an increase in longevity; and general insurers and Lloyd's syndicates were asked to assess their solvency position against a set of insured natural catastrophe (NatCat) and cyber losses.

We would like to thank all participants for their cooperation in enabling us to meet the three objectives of this exercise; namely:

- 1) assessing sector resilience;
- 2) supporting capacity building in risk management; and
- 3) guiding supervisory activity.

This letter sets out our findings on sector resilience and provides thematic observations that support improvements in risk management. PRA Supervision teams will use individual firm responses to inform their supervisory strategy, which may result in follow-up discussions and actions.

Context

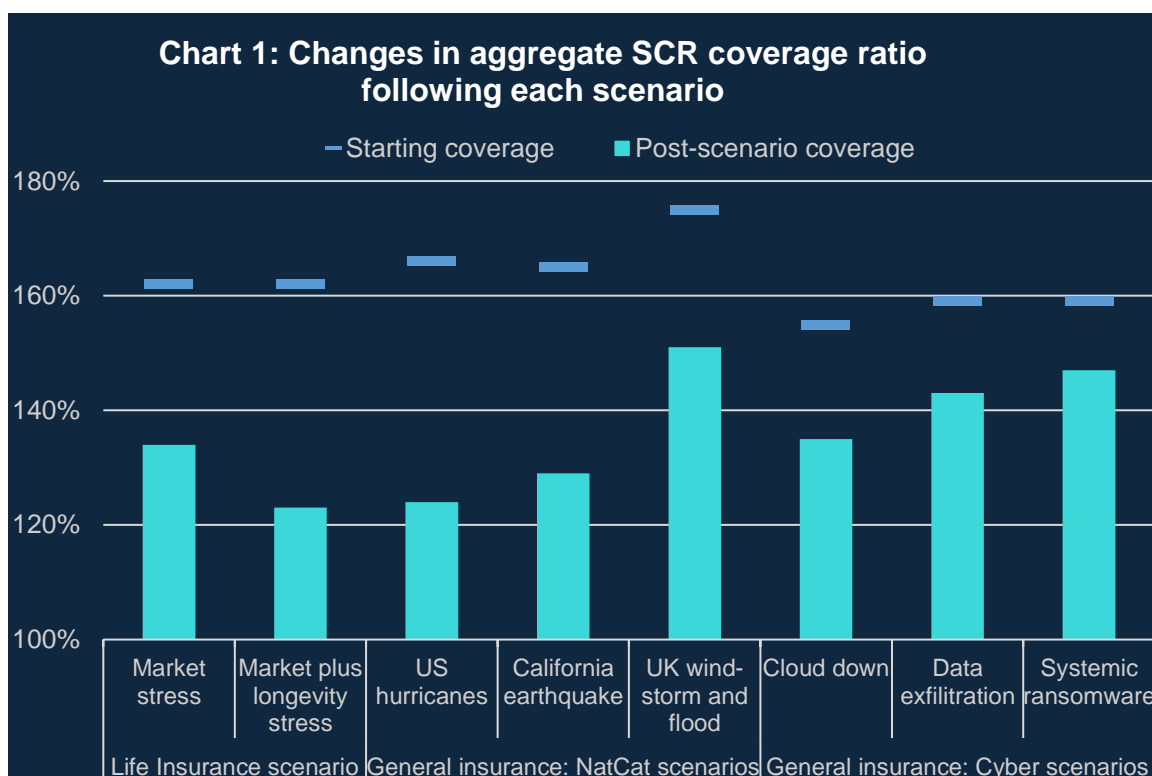
The IST 2022 scenarios were developed between August 2021 and March 2022, following two rounds of industry engagement.¹ These scenarios remain relevant for

¹ <https://www.bankofengland.co.uk/prudential-regulation/letter/2022/May/insurance-stress-test-2022>.

insurers; nevertheless, changes in the external and economic environment during 2022 illustrate the importance of firms developing and adapting their own scenario analyses (in addition to any regulatory-led exercises such as IST 2022). For insurers, the main sectoral risks not explicitly considered quantitatively within this exercise are liquidity and the broader implications of a higher inflationary environment. These risks will be considered in developing future stress test exercises.

Summary findings

1. The results indicate that the UK insurance sector is resilient to the PRA-specified scenarios, subject to a number of mitigating measures, while highlighting and supporting the need for ongoing focus in a number of priority areas. These are consistent with those set out in our recent ‘Insurance supervision: 2023 priorities’ letter,² in particular, around financial resilience, risk management, and reinsurance risk.
2. In aggregate for IST 2022 participants, the life insurance sector’s solvency capital requirement (SCR) coverage falls from 162% to 123% and the general insurance sector’s SCR coverage remains above 120% in all scenarios.³



Sources: Firm submissions and PRA calculations. Results for individual scenarios include all participating life insurers, but only participating general insurers for whom the scenario was material.

² <https://www.bankofengland.co.uk/prudential-regulation/letter/2023/insurance-supervision-2023-priorities>.

³ Aggregate results are based on firms’ final submissions without PRA adjustment.

3. For life insurers, the impacts of credit downgrades, property shocks, and longevity improvement in the stress scenario are the largest drivers of the decline in solvency coverage. Existing reinsurance assets and assumed management actions act to dampen the effect of the scenario. Also of note, are two components of the Solvency II regime:
 - Matching Adjustment (MA): In the spread widening stress, the MA increases to offset most of the corresponding fall in asset values within the MA portfolio; and balance sheet deterioration through increased credit risk is not observed until assets start to downgrade. While this result is to be expected under the regime, it does illustrate that the MA does not automatically take account of market signals relating to elevated credit risk at the point where they start to come through. As such, firms' risk management needs to be able to respond to distressed asset vulnerabilities in their MA portfolios.
 - Transitional measure on technical provisions (TMTP): Following the scenario, the aggregate absolute amount of TMTP does not change significantly; however, many firms become more reliant upon it, representing an aggregate benefit of c. 30% to solvency cover under the scenario. This highlights that it is important for firms to review their phasing-in plans to cover the SCR with eligible own funds when TMTP expires on 1 January 2032.
4. For general insurers, the primary mitigant for losses is reinsurance from both third-party and related party reinsurers. The scale of mitigation varies by firm, reflecting both the quantum of gross losses they are exposed to as well as the differing reinsurance and capital strategies. While this exercise finds that external reinsurance is well diversified, it also highlights the importance of the availability, contractual performance, and structural suitability of reinsurance protection, and the need for firms to proactively manage reinsurance counterparty concentrations.
5. This exercise has also identified some common gaps in data and modelling, and highlighted examples of better practice in risk management. A summary of the main points is set out below, and additional observations are set out in the annexes.
 - For life insurers, this exercise highlights the potential concurrent management actions across the financial sector under our specific scenario, thereby challenging the effectiveness of certain management actions noted by firms in this exercise. Firms should, therefore, consider how realistic it is for them to be able to sell assets in conditions following

a market wide stress where there may be few willing buyers. Boards should increase their focus on the feasibility of management actions and the impacts beyond the immediate effect on their firm's solvency position. This includes consideration of the actions and impact on markets from other investors following a stress.

- For general insurers, this exercise has identified a number of areas for improvement in quantifying NatCat losses (eg secondary perils⁴ and post loss amplification (PLA)⁵), cyber losses (identification of key exclusions), and other second-order balance sheet items (risk margin, discounting, tax, unexpired risk⁶). Current practices could lead to a misestimation of scenario impacts for individual insurers.
- The level of governance that this exercise was subject to varied across participants. It is important that the results of this exercise benefit from board scrutiny and discussion and we encourage firms to increase visibility and engagement of stress testing at board level.

We encourage boards to assess whether the risk management findings and gaps highlighted above and in the annexes apply to their firm and, if so, to commission an action plan to address them.

Next steps

In an external environment of high volatility and uncertainty, stress and scenario testing will become an even more important tool for firms to assess their own resilience, and for the PRA in pursuing a forward-looking, proportionate, and judgement-based approach to supervision.

For life insurers, we intend to engage with firms during Q2 2023 on the timing of the next exercise and developments in structural design and disclosure requirements. The publication of results for selected individual firms is an opportunity to enhance the effectiveness of market discipline in complementing prudential standards and to give market participants continued confidence in them as counterparties.

⁴ Secondary perils refer to events that have a lower potential for causing damage than a territory's loss-driving (primary) peril; they are not generally used directly in catastrophe risk pricing.

⁵ PLA captures the effect of a catastrophe event increasing costs. This could be for a number of reasons, including increased repair costs from material shortage (economic damage surge) or increased costs due to a high number of claims (claims inflation).

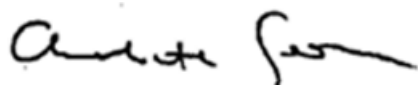
⁶ Unexpired risk refers to claims and related transactions arising from future events that are covered by in-force insurance and reinsurance contracts.

For general insurers, we expect to engage with the industry in Q3 2023 on the timing and design of the next iteration of the exercise once we have considered the implications of any changes to the life insurance stress test.

Finally, the annexes provide results and risk management observations that will be of particular interest to your risk function. We will be hosting two separate industry forums (one for life insurers and one for general insurers). If you would like to attend one of these please contact IST.2022@bankofengland.co.uk.

Our thanks again for your participation in Insurance Stress Test 2022.

Yours sincerely



Charlotte Gerken

Executive Director

Insurance Supervision

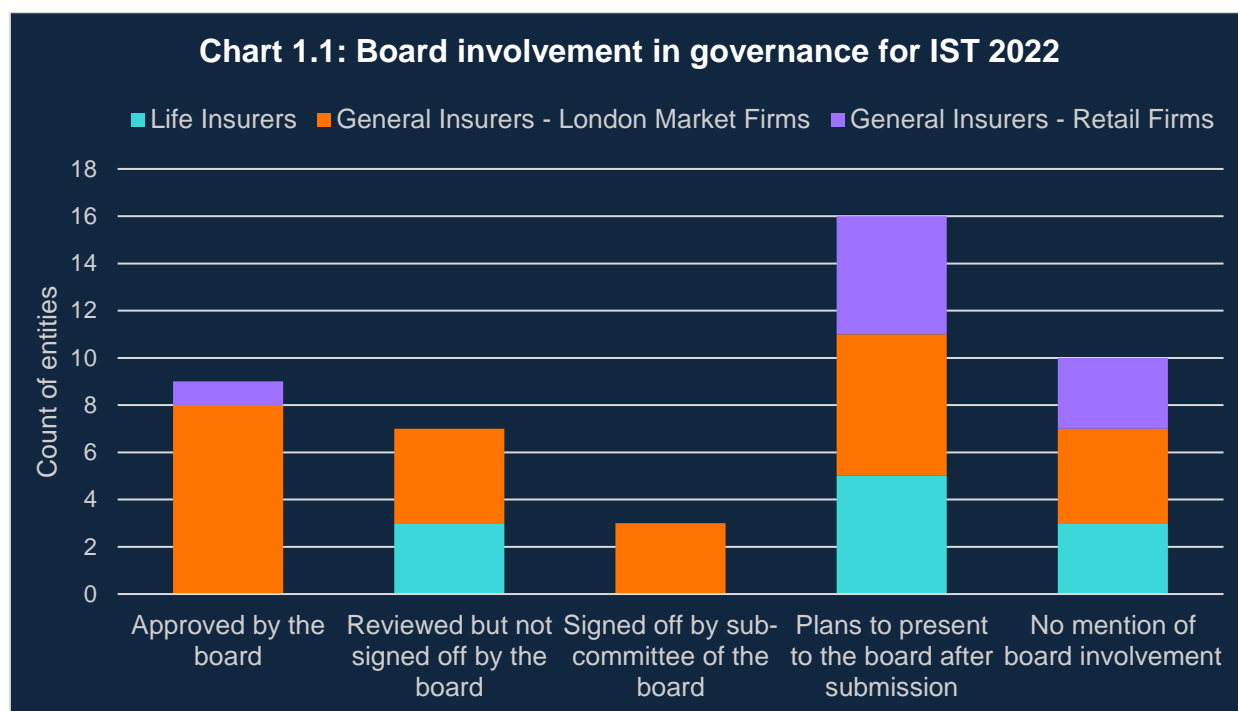
ANNEX 1: Governance and quality assurance

Governance

The level of governance that this exercise was subject to varied across participants, with some leveraging existing processes, whilst others established project teams.

Chart 1.1 suggests that more general insurers than life insurers are at a higher maturity of governance for supervisory stress testing.

It is important that the results of this exercise benefit from board scrutiny and discussion, and we encourage greater visibility and engagement in this area.



Sources: Firm submissions and PRA calculations. Results were aggregated across Group entities.

Quality assurance

Firms generally reported challenge during the production and validation processes covering both methodology and outputs. However, better firms gave concrete examples (rather than generic statements) and highlighted areas where changes had been made following these challenges.

More comprehensive responses provided alternative calculation methods, comparison to Internal Model benchmarks and outputs (including to the PRA’s market risk sensitivities and Standard Formula results where applicable), and contained calculation checks looking at benchmarking the results against independent historical points of reference.

ANNEX 2: Life insurers feedback

This is the second time since the introduction of Solvency II that we have asked life insurance firms to participate in a stress testing exercise. We invited 16 UK regulated life entities across 12 groups to complete the exercise.

The IST 2022 design and specifications (which drew on learnings from the first life IST in 2019), coupled with good industry engagement, have enabled us to publish aggregate results. Firms have provided comprehensive responses to IST 2022, and we have been able to assess and confirm adequate comparability of firms' reported results. The published aggregate results will enable us, and other stakeholders, to assess the resilience of the sector to market and longevity stresses specified by the PRA.

The stress scenario captured adverse economic and longevity shocks; the full details of the life insurance scenario are available in our publication on 4 May 2022.⁷

The scenario was designed to focus on the most material financial risk exposures for those life insurers with significant exposure to annuities. For this reason, the level of inflation was not explicitly stressed despite the developments since the start of 2022 and instead a qualitative assessment of the impact of inflation was requested. The responses from firms indicate that they are hedged against inflation for solvency purposes; however, many identified longer-term wider impacts of inflation on growth, economic activity, credit outlook, and customers.

Key messages

The sections below set out a number of the PRA's observations and expectations. We would particularly highlight:

1. The selected scenario demonstrated the significance of credit downgrade risk to the industry. Firms need to have adequate risk management in place in relation to this risk, with the board setting appropriate risk appetites, ensuring that these appetites are put into practice throughout the business and assessing the position against a range of scenarios.
2. When a firm considers trading management actions that it would plan to take in stress, it is important to allow for market liquidity and potential stress amplifications arising from actions that would be expected to be taken by other investors.

⁷ <https://www.bankofengland.co.uk/prudential-regulation/letter/2022/May/insurance-stress-test-2022>.

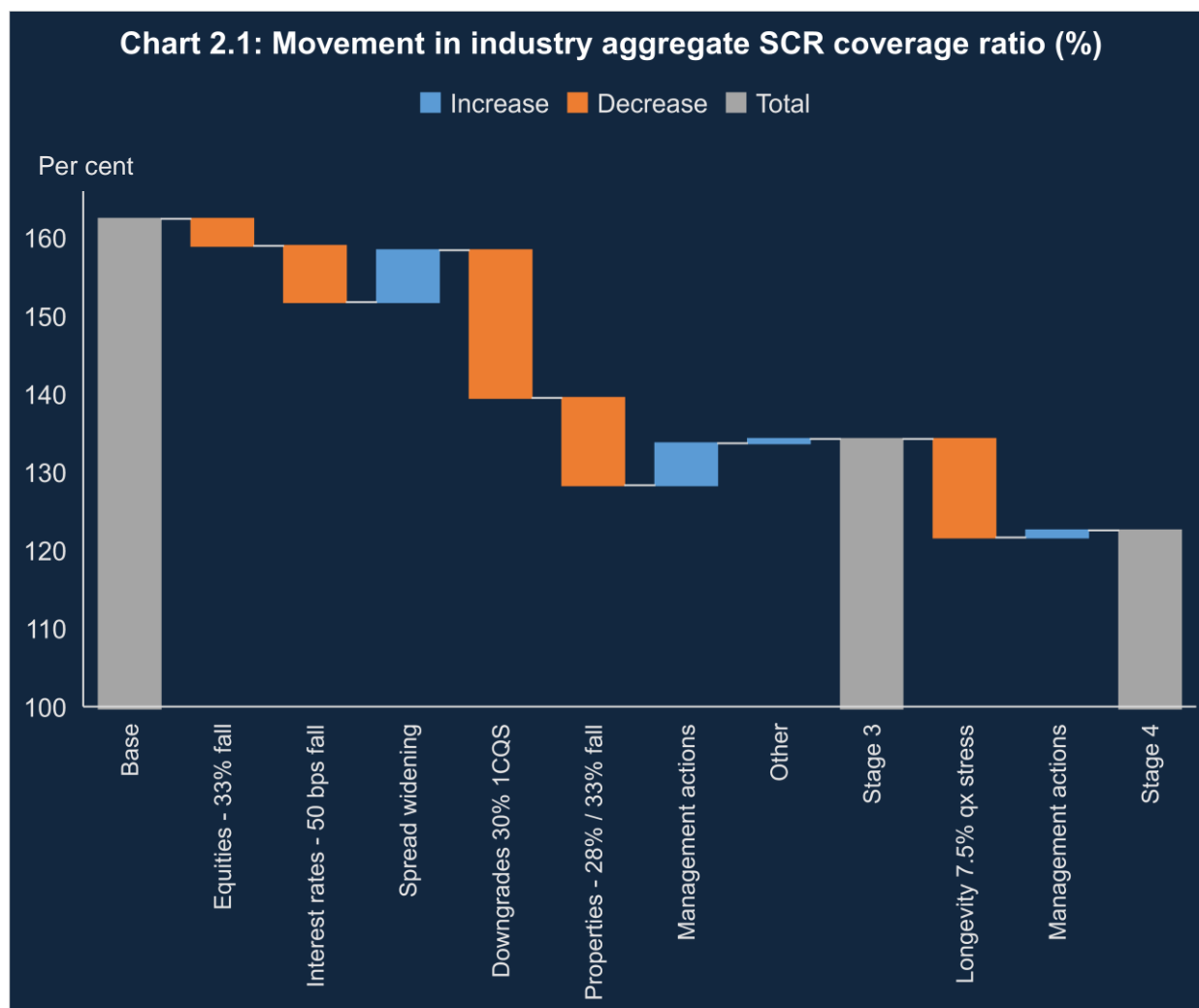
3. This scenario highlighted the current benefit to firms of using TMTP to enable them to meet their SCR in stressed conditions. It will continue to be important for firms to ensure that they have adequate phasing-in plans setting out how they plan to cover the SCR with eligible own funds when TMTP expires on 1 January 2032.

These are discussed in further detail later in this annex.

Life insurance scenario results

The results reported by firms demonstrate that **major life firms' solvency is resilient to the financial market shocks** set out by the PRA. For the specified stress scenario, the greatest vulnerability was to credit downgrades, property shocks and longevity improvements (albeit reinsurance offsets a significant proportion of the longevity risk). The aggregate across-the-sector SCR coverage remained above 100% and none of the entities breached its MCR.

The PRA market shock scenario is a severe stress reducing the participating life firms' aggregate capital surplus above the regulatory capital requirements from £34.2 billion to £18.4 billion (solvency cover reduction of 28 percentage points) through to Stage 3, during which firms were allowed to apply permitted management actions. In Stage 4, the longevity stress further reduces this surplus to £12.3 billion (a further solvency cover reduction of 12 percentage points), after allowing for the benefit of existing reinsurance arrangements and, for some firms, further management actions.



Sources: Firm submissions and PRA calculations.

The SCR coverage ratio is the aggregate of participants' eligible own funds divided by the aggregate of their SCRs. It allows for recalculation of TMTP at each stage. It should be noted that the granular analysis of change by risk driver in the waterfall chart is approximate and relies in part on certain estimates (based on other information previously submitted by firms) as the analysis provided by firms varied in level of granularity and detail.

The main drivers of the change in the SCR coverage ratio at an aggregate level were:

- **Equities stress:** eligible own funds reduce, partially offset by SCR reducing.
- **Interest rate stress:** the SCR increases, partially offset by eligible own funds increasing.
- **Spread widening stress:** the SCR reduces, partially offset by eligible own funds reducing.
- **Downgrades 30% 1 Credit Quality Step (CQS) stress:** a combination of SCR increasing and eligible own funds reducing.

- **Property stresses:** a combination of SCR increasing and eligible own funds reducing.
- **Management actions up to Stage 3:** primarily results in a reduction in SCR thereby increasing the SCR coverage ratio.
- **Longevity stress:** eligible own funds reduce, accompanied by a lesser increase in the SCR.

While the industry aggregate SCR coverage ratio remains above 120%, a number of life insurers would be expected to breach their internal risk appetite limits. The likelihood of breaching these limits varies by firm, depending on a combination of the business model, risk exposures, and capital coverage surplus at the time of this exercise.

In total, four firms see their solvency coverage reduced to red⁸ solvency risk appetite or lower, with one entity breaching 100% SCR coverage at Stage 3. Following the additional longevity shock at Stage 4, five firms are within or beneath their red risk appetite for solvency coverage, with two of them breaching 100% SCR coverage. Those entities would need to rely on material actions that were not permitted to be recognised as part of this exercise, including injections of capital to restore their coverage ratios to their target capital risk appetite.

It should be noted that firms differed in the extent to which they applied permitted management actions. Better placed firms focused on ensuring that the assumed management actions reflected those that they would expect to take in such a stress scenario ahead of attempting to optimise the reported stressed balance sheet.

Downgrades and defaults

The impact of downgrades in the stress scenario was the largest driver of change in solvency coverage.

We have previously set out that we expect a firm's board to have a clear understanding and oversight of exposure to credit downgrades and defaults, as well as the impact this would have on the firm's financial position and ability to recover from losses. Firms

⁸ A number of firms set red, amber, and green risk appetites for their business, where red risk appetite is when critical capital levels are breached. It should be noted that we have adjusted the colour-coding of the risk appetite ranges set by some firms in order to ensure a degree of consistency when comparing firms. In particular, the red zone defined by the PRA for the purposes of this exercise represents a zone that is bounded below by 100% SCR coverage, where either the firm has identified detriment to its business model (and is therefore uncomfortable being in this zone to a much greater extent than being in the amber zone) or where management actions to boost its SCR coverage become mandatory (beyond any management actions that were triggered in the amber zone).

need to have adequate risk management in place in relation to this risk, with the board setting appropriate risk appetites, ensuring that these appetites are put into practice throughout their business and assessing their position against a range of scenarios.

We would remind firms of the PRA's existing expectation (set out in SS4/18 – 'Financial management and planning by insurers')⁹ that when deciding on distributions – including dividends – boards should satisfy themselves that each distribution is prudent and consistent with their individual exposures and risk appetite.

Management actions

Ability to sell investments in stress: Several firms relied on the ability to sell liquid 'BBB' rated assets following their downgrade to sub-investment grade and reinvest the proceeds in investment grade assets in response to the stress. Overall, during the scenario, between £8 billion and £9 billion of liquid sub-investment grade assets were assumed to be sold by life insurers. Most participants assumed in Stage 3 that they would be able to sell sub-investment grade assets within 6 to 12 months following the stress. In light of the aggregate finding, this could be optimistic, especially as other investors would also be taking similar actions. It is important that, when firms plan for the management actions that they could take in stress, they allow for market liquidity and potential stress amplification arising from actions taken by other investors. The market liquidity and stress amplification will change with the level of market stresses.

Trading costs: A number of firms had not allowed for trading costs, and did not provide any explanation for this. The management action restrictions reduce the likelihood that differences in trading costs would materially affect the consistency and comparability of results between firms. However, this highlights that firms should take into account the uncertainty in costs and losses arising from trading management actions, particularly in volatile markets.

Interdependencies: Few firms recognised interdependencies between management actions in the commentary that they provided, in particular those they would intend to use to restore their coverage ratios to their target capital risk appetite. For example, the amount of capital required to restore coverage ratios to their target capital risk appetite depended on first completing trading out of sub-investment grade bonds.

Additional management actions: Firms differ in the extent to which they considered they had plausible additional management actions (beyond those permitted) that they could take to improve their regulatory balance sheet. In addition, firms had not always considered whether the combination of the stress scenario and the management

⁹ <https://www.bankofengland.co.uk/prudential-regulation/publication/2018/financial-management-and-planning-by-insurers-ss>.

actions that were assumed to be taken would change their risk appetite thresholds, thereby potentially changing the scale of the additional management actions required to restore their target risk appetite. We would expect firms to understand the sensitivity of their risk appetite thresholds to stress and not simply assume that they would remain constant.

Offsetting impacts of TMTP: The exercise highlighted to many firms that some or all of the financial benefits from management actions were offset by a consequential reduction in TMTP.

Reinsurance

Existing longevity reinsurance is another mitigant, decreasing the impact of the longevity stress from c. 30% to c. 13% of SCR cover.¹⁰ Reinsurer concentrations are well diversified with the largest exposure equating to 15% of the present value of the sector's longevity reinsurance claims. Geographically, nearly 70% of the reinsurance exposure is to reinsurers based in Bermuda, USA, Germany, Ireland, and Canada.

Further commentary on reinsurance is provided in annex 4.

Transitional measure on technical provisions

TMTP remains a significant component for firms' own funds with its relative significance for enabling firms to cover SCR significantly increasing in the scenario. In aggregate, the participating firms recognised £23.7 billion of TMTP in Stage 4 of the scenario. For some firms, in the absence of other de-risking measures, the market stress specified within the scenario will be more material as we reach the end of the transitional period. This highlights the continued importance to us of monitoring firms' TMTP and reviewing the phasing-in plans that firms are required to submit to the PRA setting out how they plan to cover the SCR with eligible own funds when TMTP expires on 1 January 2032.

Operational insights

Firms that had deployed a broad multi-disciplinary team in responding to this exercise provided more comprehensive information within their Results and Basis of Preparation report. These firms had found the exercise helpful, with a greater range of learnings.

We had not specified an expectation regarding the format of the narrative response that supports the quantitative results. However, we note that some firms were able to provide a highly granular analysis whereas others provided very little detail. The former

¹⁰ The value of 30% only allows for the movement in reinsurance assets (not any impact on the risk margin or SCR).

provided useful insights into the dynamics of the scenario and will inform the design of future exercises.

Several life insurers highlighted that this exercise had allowed them to explore impacts of different management actions and the value of multi-factor stress testing, and to identify limitations in their in-house stress tests.

The staged scenario with management action restrictions highlighted to a number of firms exposure to risks if they were unable to adjust their hedging in time. However, this also highlights firms' exposure to risks in volatile markets where they have inaccurate data to adjust their hedging.

We continue to observe that modelling capability limits the sector's ability to assess the full range of potential management actions.

ANNEX 3: General insurers feedback

The 17 largest PRA-regulated general insurers, 21 large syndicates and the Society of Lloyd's participated in this stress test exercise. These entities accounted for £71 billion of Gross Written Premium, representing just under three-quarters of the UK general insurance sector.

The stresses consisted of three Natural Catastrophe (NatCat) scenarios and three cyber underwriting scenarios. The full details of the scenarios and their design are available in our publication on 4 May 2022.¹¹

In general, firms adopted a variety of approaches in responding to this exercise, and in particular in addressing the novel aspects of these scenarios (such as assessing losses from a UK west coast storm surge). However, the supporting justification was often limited. In many cases, differences between firms could be a function of differing business models and risk profiles, but could equally result in potentially significant differences in judgement calls. In providing industry aggregate results, and in some cases ranges, of the different modelled components we encourage risk teams and boards to challenge whether their assumptions remain appropriate.

A. Natural Catastrophe risks

Key messages

This exercise provides evidence of improvements in modelling capabilities: This exercise is the fourth time we have asked entities to consider NatCat events. The quantitative and qualitative responses indicate that overall entities' approach to modelling catastrophe risks has become more sophisticated since the first stress test in 2015. Furthermore, participating entities were generally able to address the more novel aspects of the scenarios, particularly the quantification of earthquake ground-motion uncertainty for Scenario A2, and UK west coast storm surge for Scenario A3.

Nevertheless, the exercise has also identified a number of modelling gaps:

Responses indicated that there are still components of modelling that could benefit from further development, including the quantification and assumptions of loss modifying factors such as claims inflation, PLA, and secondary uncertainty.¹²

The exercise also highlights continued dependency on reinsurance: This exercise highlighted that UK general insurance entities continue to be materially dependent on

¹¹ <https://www.bankofengland.co.uk/prudential-regulation/letter/2022/May/insurance-stress-test-2022>.

¹² Secondary uncertainty refers to the uncertainty in the loss estimation given an event of certain magnitude has occurred; it is quantified by the standard deviation of loss distribution.

the global reinsurance market to mitigate the financial impact of gross losses. Further commentary on reinsurance is provided in annex 4.

NatCat scenarios: sector resilience

Table 3.1 indicates that participating entities in aggregate are able to withstand the NatCat stresses, with the one-year SCR coverage ratio remaining above 100%. Within each of the scenarios, the majority of participating entities experience an erosion in SCR coverage of between 10 percentage points and 60 percentage points, although some experience notably larger erosions.

The split of the losses by peril are in line with the PRA's expectations for each scenario based on the description of the events and instructions outlined in the exercise guidelines.

Table 3.1: Solvency ratios and possible regulatory breaches ^{(a) (b) (c) (d)}

As at 31 December 2022	Scenario A1: US hurricanes	Scenario A2: California earthquake	Scenario A3: UK wind- storm & flood
In scope entities	28	28	38
Coverage ratio before scenario	166%	165%	175%
Coverage ratio after scenario	124%	129%	151%
No. of entities (where <100% SCR coverage)	5	4	1
Average coverage (where <100% SCR)	79%	79%	80%
No. of syndicates with net loss > 30% of ECA	7	2	0

Sources: Firm submissions and PRA calculations.

- (a) Includes only those participants for whom the impact of the scenario is deemed material. (Note: results in this table include participating syndicates but exclude the Society of Lloyd's).
- (b) For syndicates, the calculation assumed eligible own funds equal to their ECA (see note d). It does not take account of the Lloyd's chain of security for syndicates.
- (c) The coverage ratio post stress has been calculated as follows: eligible own funds adjusted for increase or decrease in basic own funds from stress divided by post stress SCR.
- (d) ECA refers to the Economic Capital Assessment, the minimum syndicate-level capital set by Lloyd's.

Table 3.2: Details of net and gross losses and reinsurance flows ^(a) ^(b) ^(c)

As at 31 December 2022	Scenario A1: US hurricanes	Scenario A2: California earthquake	Scenario A3: UK wind- storm & flood
Estimated market loss (£billion)	155.6	55.6	20.0
Likelihood of event (vendor view)	1 in 150	1 in 250	1 in 250
Gross loss (£billion)	20.4	19.9	22.7
Gross loss, as % of market loss	13%	36%	100%
Net loss (£billion; net of reinsurance)	7.2	6.1	5.2
Total % of gross loss ceded	60%	66%	77%
- intra-group arrangements ^(c)	15%	15%	26%
- SPV reinsurers ^(c)	10%	8%	1%
- Bermuda based reinsurers ^(c)	26%	22%	21%

Sources: Firm submissions and PRA calculations.

(a) Includes only those participants for whom the impact of the scenario is deemed material. (Note: results in this table include the aggregate Society of Lloyd's instead of participating syndicates).

(b) All amounts in £billion [1:1.35 to USD].

(c) Reported as percentage of reinsurance recoveries.

The main mitigant to reduce the gross loss impact of each scenario was reinsurance (Table 3.2). Although a direct comparison is not possible (due to changes in participants and events), the level of reinsurance recoveries is similar to the previous IST in 2019, but reinsurer concentration has marginally increased, reflecting an increase in the use of intra-group reinsurance. Third-party reinsurance remains well diversified, with the largest external reinsurance counterparty representing around 9% of expected recoveries (see also annex 4).

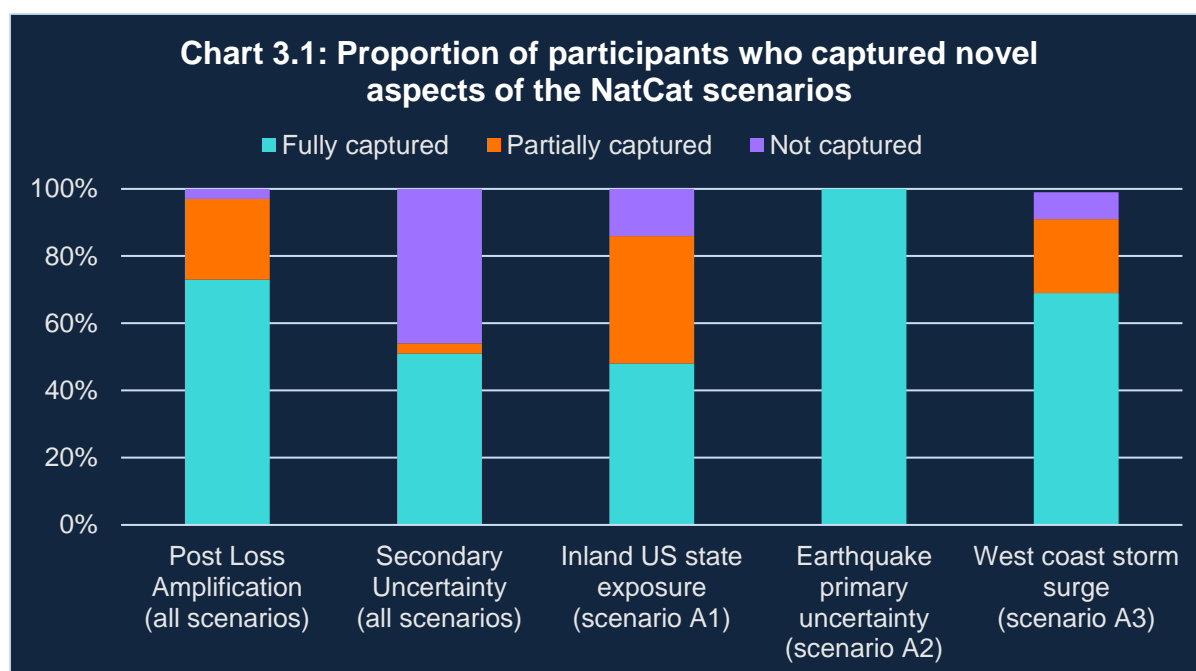
The use of Special Purpose Vehicles (SPVs), while common for US NatCat exposures, remains modest at c. 6% of gross losses. Use of SPVs is minimal under the UK scenario.

Allowance for risks not captured within standard models

The 2022 NatCat scenarios built on the 2019 IST exercise by further exploring potential gaps in NatCat model coverage. This included inland US exposure to hurricanes, California earthquake primary uncertainty and UK west coast storm surge. Across all

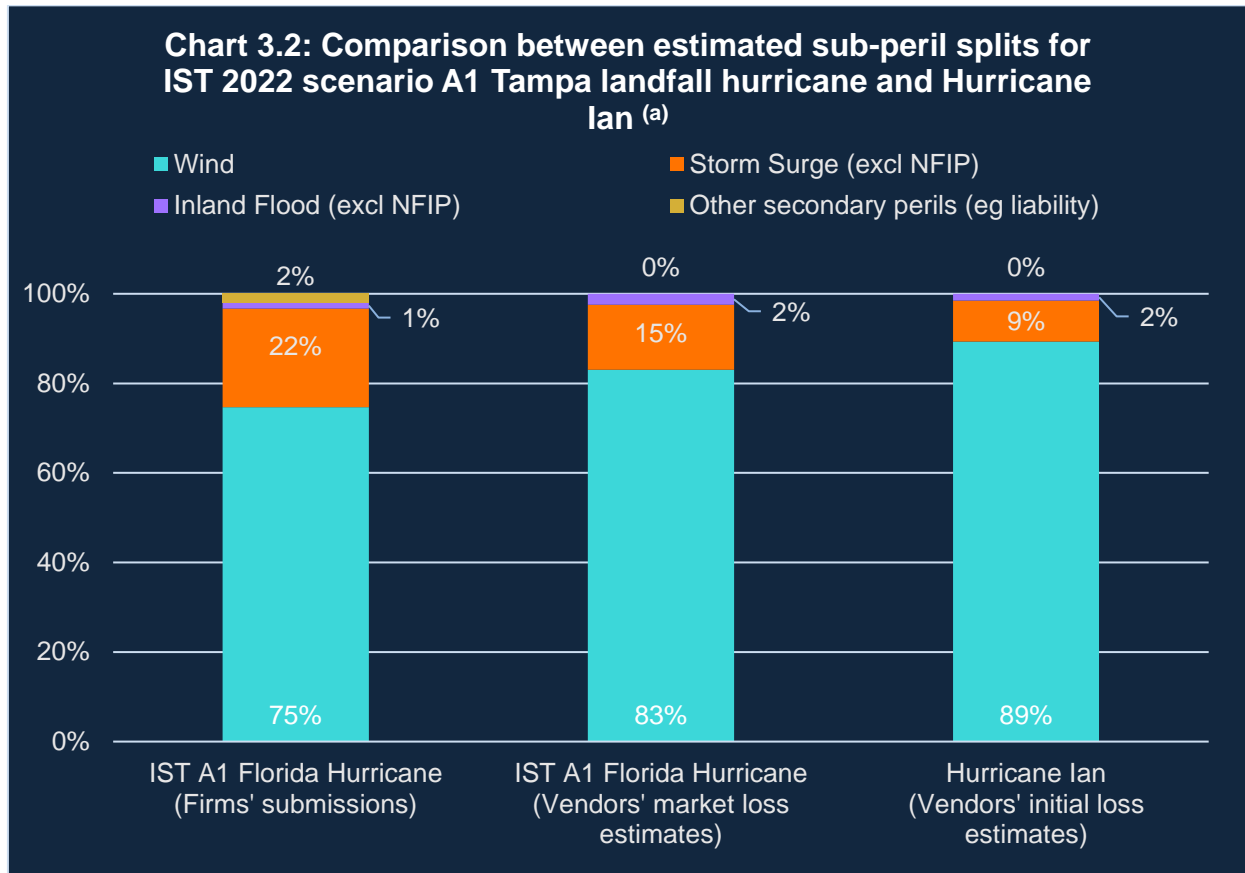
three scenarios, we also investigated the way participating entities captured PLA and secondary uncertainty.

Participating entities were generally able to report on these more novel aspects of the scenarios, particularly the quantification of earthquake ground-motion uncertainty for Scenario A2, and UK west coast storm surge for Scenario A3 (Chart 3.1). However, many participants treated these as cursory, instead of an opportunity to evolve their modelling approaches; a few firms did acknowledge an intention to address these modelling gaps in the near future. This remains an area of interest to the PRA and we encourage firms to reflect on the limitations of their models and any need to remedy modelling gaps.



Sources: Firm submissions and PRA calculations.

Due to similarities between Hurricane Ian and scenario A1 event 1 (including physical characteristics and the approximate location of landfall), we have been able to compare the assessment of secondary perils associated with hurricanes between the scenario and a live event. We find that secondary perils contribute more to the IST scenario A1 gross losses than the initial loss estimates for Hurricane Ian provided by catastrophe model vendors in November 2022, as shown in Chart 3.2. Comparing this to a similar benchmarking of the previous IST scenarios indicates that firms have improved their ability to capture secondary perils since 2019. We encourage firms to continue including comparisons to real-world events in their catastrophe model validation and to take steps to remediate any material gaps.



Sources: Firm submissions, vendors' estimates and PRA calculations.

(a) The National Flood Insurance Program (NFIP) is a US flood insurance programme for property owners, renters and businesses managed and administered by the Federal Emergency Management Agency (FEMA).

B. Cyber underwriting risk

Building on the exploratory 2019 cyber scenario, IST 2022 considered three cyber scenarios: cloud outage, mass data exfiltration, and systemic ransomware.

We note that cyber is an evolving peril, and consequently cyber coverage will continue to develop. This exercise has provided us with a wide range of current practices across the market, which will inform future supervision.

Key messages

Assessment of the likelihood of tail risks was highly variable: This exercise has highlighted significant variation in the perceived likelihood that firms attach to the cyber scenarios set out in this exercise. For relatively new products, such differences of opinion are not necessarily unusual. However, as the market continues to expand, and the size and impact of cyber within the insurance market increases, we encourage the market to develop greater consensus to ensure capital comparability across the sector.

Ability to identify the implications of contract uncertainty was mixed: The ability to assess the potential impact should key exclusions not hold was highly variable, with a

number of firms unable to carry out this request. We encourage boards to be aware of the implications of the inherent untested policy language and the possibility of contractual uncertainty, ensuring exposures continue to be managed within their firm's own risk appetite.

The percentage of potential claims identified as arising from non-affirmative covers is reducing: Non-affirmative loss has reduced significantly in comparison to the 2019 results. We encourage firms to continue to robustly assess and actively manage this exposure, as outlined in SS4/17– 'Cyber insurance underwriting risk'.¹³

Reinsurance continues to be an important mitigant: This exercise highlighted that UK general insurance entities continue to be materially dependent on the global reinsurance market to mitigate the financial impact of gross losses. Further commentary on reinsurance is provided in annex 4.

Cyber underwriting scenarios: sector resilience

Based on our findings, the UK general insurance sector, as represented by the sample of participating entities, appears resilient to all three of the IST 2022 cyber scenarios.

Table 3.3: Cyber underwriting scenario results (a) (b) (c) (d) (e)

As at 31 December 2021	Scenario B1: cloud down	Scenario B2: data exfiltration	Scenario B3: systemic ransomware
In scope entities	27	28	28
Coverage ratio before scenario	155%	159%	159%
Coverage ratio after scenario	135%	143%	147%
No. of entities below 100% SCR coverage	2	1	1
Average coverage (where <100% SCR)	88%	97%	94%
No of syndicates with net loss > 30% of ECA	1	1	0

Sources: Firm submissions and PRA calculations.

- (a) Includes only those participants for whom the impact of the scenario is deemed material. (Note: results in this table include participating syndicates but exclude the Society of Lloyd's).
- (b) For syndicates, the calculation assumed eligible own funds equal to their ECA (see note e). It does not take account of the Lloyd's chain of security for syndicates.

¹³ <https://www.bankofengland.co.uk/prudential-regulation/publication/2017/cyber-insurance-underwriting-risk-ss>.

- (c) The coverage ratio post stress has been calculated as follows: eligible own funds adjusted for increase or decrease in basic own funds from stress divided by post stress SCR.
- (d) It is assumed that the stress occurs at the beginning of the year 2022 and impact is assessed on YE 2021 balance sheet.
- (e) ECA refers to the Economic Capital Assessment: the minimum syndicate-level capital set by Lloyd's.

We note that industry loss estimates are potentially overstated as each scenario required insurers to select their most material exposures when assessing potential insured losses, for example, their most significant cloud service provider (CSP). Nevertheless, these figures help illustrate the growing exposure and importance of cyber underwriting for commercial insurers.

Table 3.4: Details of net and gross losses and reinsurance flows ^{(a) (b) (c)}

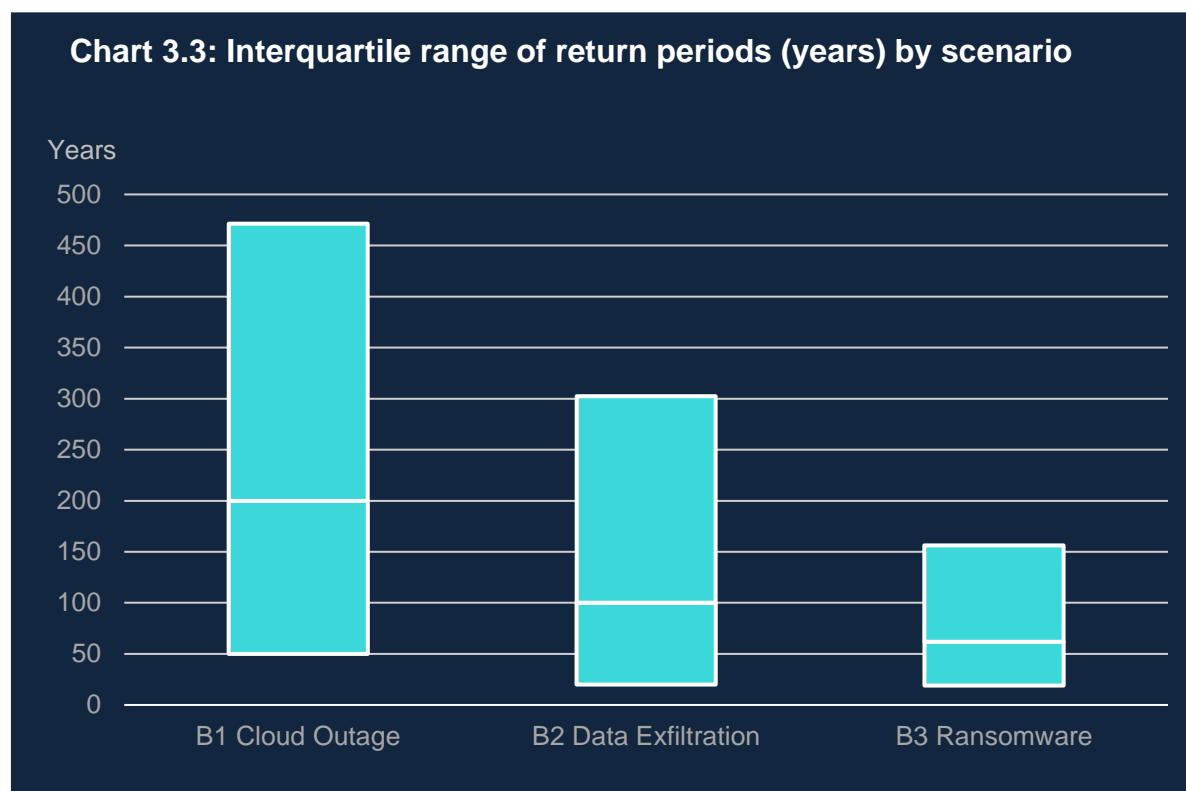
As at 31 December 2021	Scenario B1: cloud down	Scenario B2: data exfiltration	Scenario B3: systemic ransomware
Quartile range of return periods [industry loss]	1 in (50 to 500)	1 in (20 to 300)	1 in (20 to 160)
Gross loss (£billion)	9.2	6.9	4.4
Net loss (net of reinsurance, £billion)	4.0	3.3	1.9
Total % of gross loss ceded	56%	52%	57%
- Germany based reinsurers ^(c)	17%	20%	20%
- Bermuda based reinsurers ^(c)	15%	14%	17%

Sources: Firm submissions and PRA calculations.

- (a) Includes only those participants for whom the impact of the scenario is deemed material. (Note: results in this table include the aggregate Society of Lloyd's instead of participating syndicates).
- (b) All amounts in £billion [1:1.35 to USD].
- (c) Reported as percentage of reinsurance recoveries (RIR).

Perceived likelihood of each scenario

There was a large variation across participants in the perceived likelihood of the prescribed cyber scenarios, with more consensus around systemic ransomware than for cloud outage and data exfiltration (Chart 3.3). Such lack of consensus in the market could impact capital comparability across the sector.



Sources: Firm submissions and PRA calculations.

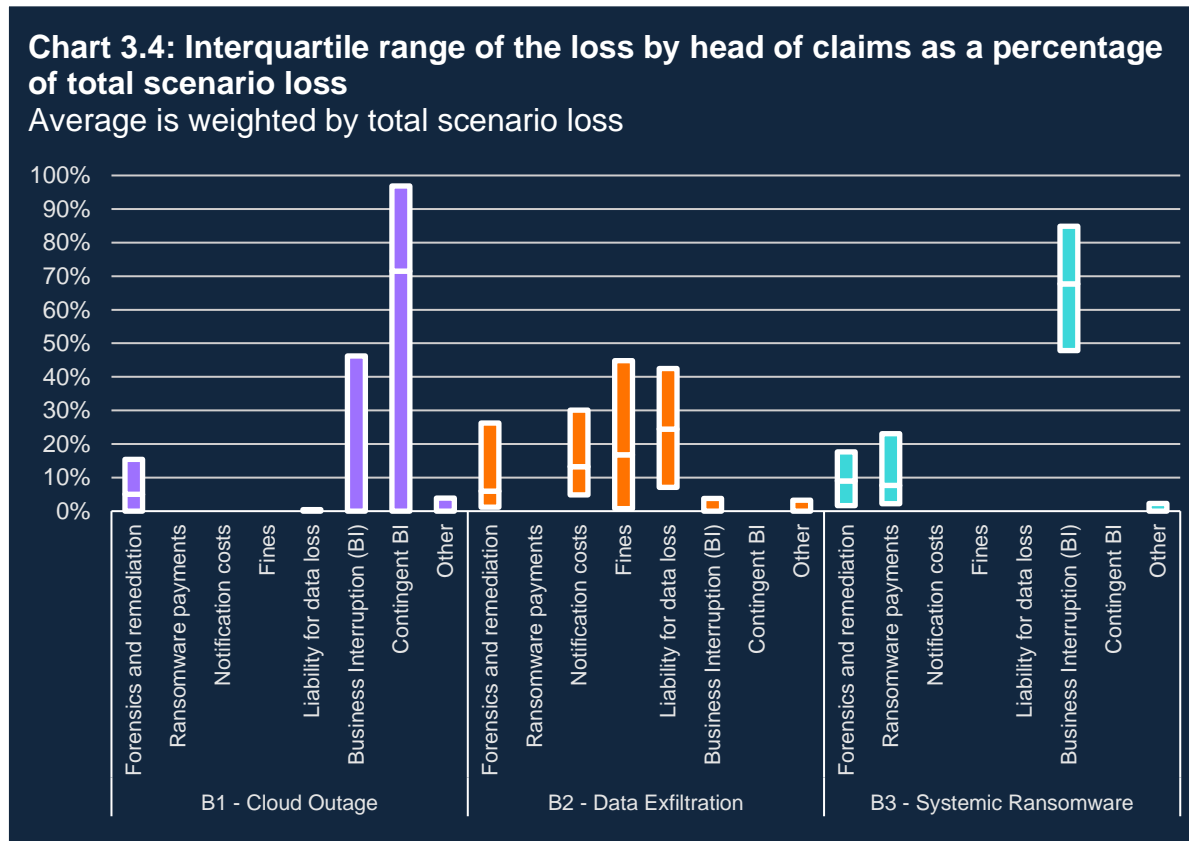
On a relative basis, the median view of return periods between the scenarios broadly aligned with industry feedback during the request for technical input. Specifically, this was that the cloud down scenario was perceived to be most remote, when considering the likelihood of a seven-day global outage of all hosted services.

However, Chart 3.3 also illustrates the considerable difference in opinion of the likelihood of these scenarios occurring, for example ranging from a perceived 1-in-50 year event to a 1-in-475 year event in the case of a cloud outage as captured in scenario B1.

Breakdown of losses and coverage

Chart 3.4 illustrates the range of calculated contribution by head of claims (for example, forensics and remediation, ransomware payments, notification costs, etc) across participants towards the total scenario losses. For example, for systemic ransomware (scenario B3), it illustrates that the main component of the losses arises from business interruption, followed by ransomware payments, and forensics and remediation costs.

The variation across participants is likely to reflect a combination of different product coverages available in the market as well as differing modelling capabilities.



Sources: Firm submissions and PRA calculations.

Entities were also asked whether there would be a difference in loss experience if the B1 cloud outage scenario was caused by technological failure ('non-malicious'). Several entities responded that the nature of the loss would make a difference, with the majority suggesting that they would expect losses to be lower. However, some entities reported no change to the loss and, where changes were expected, there was a range of responses regarding the materiality of the difference, both in regard to the severity of the loss and the degree of coverage available for such an event.

Firms should consider whether any differences in their modelled results relative to market averages (shown above) reflect coverage differences or modelling gaps. Furthermore, firms should consider the materiality of changes in modelled losses under different claims attribution assumptions, for example, whether a claim is determined as arising from a malicious or non-malicious actor.

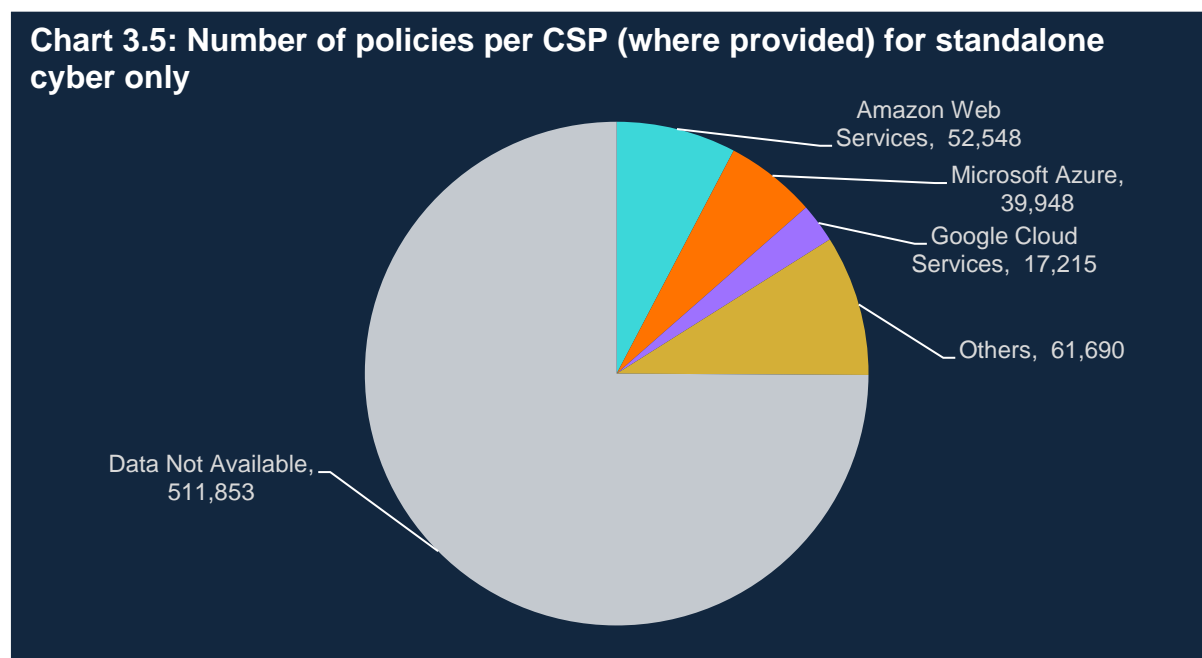
Reliance on modelling vendors

The majority of firms used at least one external vendor model as part of the IST process in addition to the deterministic assumptions that we specified, with three external models most commonly cited. Some entities blended different views of risk or validated results by accessing multiple vendor models, whether in-house or via their reinsurance broker.

In light of the growing adoption of vendor models, we encourage boards to understand the limitations and lack of convergence in existing cyber catastrophe modelling, and to ensure that they are satisfied with any measures taken to mitigate shortcomings in current approaches.

Ability to monitor exposures

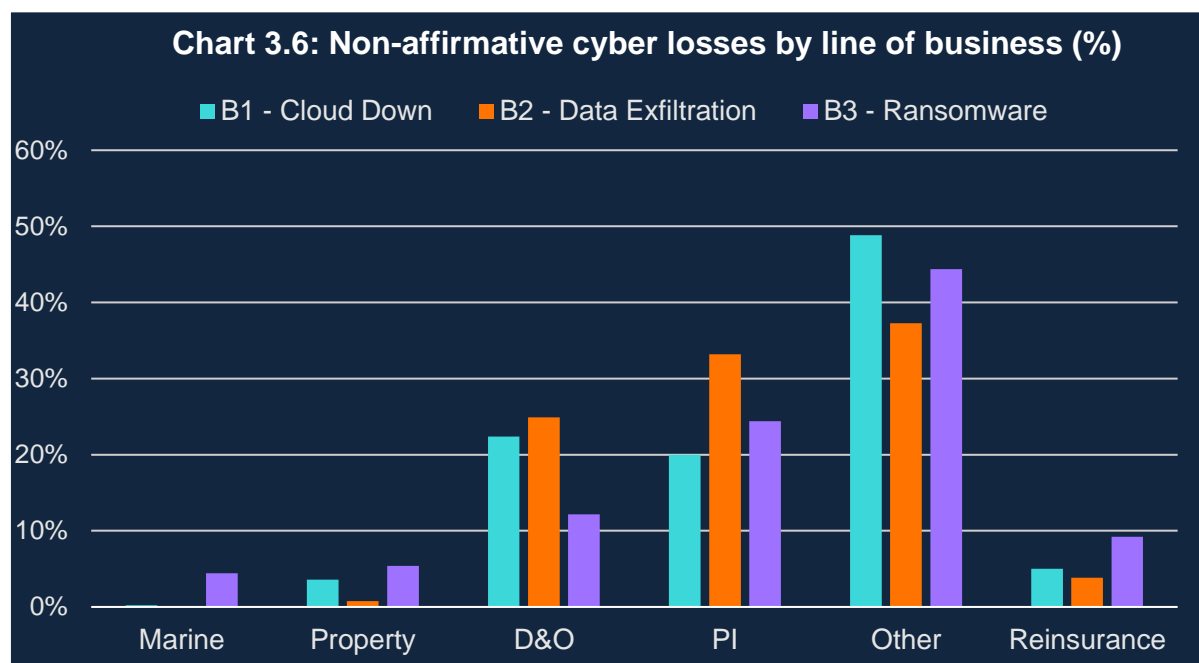
This exercise requested firms, where available, to provide details of the reliance on CSPs of their insureds. Responses on this subject were limited (representing a quarter of total policies), as seen in Chart 3.5, and where CSPs were named, some entities appear to have based this on vendor model market share assumptions rather than their own data. Qualitative detail regarding the degree of insureds' reliance on cloud services was also lacking. There were, however, positive examples by a minority of entities referencing external scanning tools to gain technographic insight.



Sources: Firm submissions and PRA calculations.

Non-affirmative cyber

The share of losses from non-affirmative exposures accounted for 7% of the total gross losses for each of the scenarios (excluding Society of Lloyd's). Several firms reported no non-affirmative losses for the scenarios (11 for B1, 14 for B2, and 9 for B3).



Sources: Firm submissions and PRA calculations.

Non-affirmative loss has reduced significantly in comparison to the 2019 results. This is likely due to market-wide efforts to affirm or exclude non-affirmative cyber following the letter to CEOs in January 2019.¹⁴ Where losses are still reported (under a named line of business) they largely come from liability lines (Directors & Officers (D&O) and Professional Indemnity (PI)) as seen in Chart 3.6. This is not unexpected given that liability lines generally use peril-agnostic triggers for coverage, such as negligence. Regarding non-affirmative cyber, we encourage firms to continue to robustly assess and actively manage this exposure, as outlined in SS4/17.

Ability to assess the impacts of contract uncertainty

IST 2022 focused on two aspects of exclusionary language in cyber, the first regards changes in gross losses should key exclusions across all lines of business not perform. Out of 28 entities, only 13 reported additional gross losses should key exclusions not perform in the systemic ransomware scenario. Of these 13 entities they reported a quartile range of 20-125% increase to their gross losses.

In general, responses regarding key exclusions were limited and generalised. However, there were select examples of better practice such as referencing exclusions and the estimated proportion of a portfolio to which they apply. Where specific language was referenced, clauses such as LMA5400 (Property) or JR-2019-13 (Energy) were featured.

¹⁴ <https://www.bankofengland.co.uk/prudential-regulation/letter/2019/cyber-underwriting-risk-follow-up-survey-results>.

The second area of focus was entities' expectations of how their war exclusions would apply should nation-state involvement be evident. Entities were broadly aligned and forthcoming in their responses that their intent was not to cover incidents or acts where such nation-state involvement was evident. However, many recognised that there are challenges and sensitivities regarding the attribution of a cyber incident or act to a nation-state. Indeed, some entities reported that they have a specific governance approach to invoking this language and have considered potential costs that may be incurred. Recent market efforts to create new language to address these challenges were also highlighted by several participants.

C. Translation of modelled results to Solvency II

Modelling the direct impacts of the scenarios in the stress test focused on quantifying undiscounted cash losses and associated expenses. To understand how these results affect regulatory solvency, adjustments are required to translate the impact of scenarios to a Solvency II basis. While these adjustments are secondary to the direct impacts, they may amplify or dampen the effect on the regulatory solvency position of an adverse scenario. The quality of explanations provided in submissions to justify or explain the calculation of the adjustments in each scenario was variable. The main Solvency II adjustments are:

- **Risk margin.** Solvency II requires a risk margin (RM) to be added to the best estimate for the purpose of calculating technical provisions and hence own funds. A scenario that increases the best estimate should result in a commensurate change to the RM. 54% of participants made an adjustment to the RM for a stress, the largest impact on SCR coverage being a reduction of nearly 5 percentage points in scenario A2 (California earthquake). An understated RM adjustment will understate the impact of the stress.
- **Discounting.** Solvency II requires the value of best estimate cash flows in technical provisions to be discounted at the relevant risk free rates (RFR). The adjustment to discount cash flows will reduce the impact of an insurance loss on technical provisions and hence on own funds. 49% of participants disclosed adjustments to discount a stress, the largest impact on SCR coverage being an increase of about 9 percentage points in scenario A2 (California earthquake). The impact of stresses will be overstated if a discounting adjustment is not made. Participants' submissions generally provided little information about RFR assumptions and the timing of cash flows in each scenario. We note that recent increases to the RFR since the effective date of IST 2022 will increase the significance of this adjustment.
- **Tax relief.** The effect of tax relief on losses may be taken into account by firms for Solvency II purposes. Tax relief is not available at syndicate level for

regulatory purposes. Only a few firms allowed for the effect on tax, which could mitigate a loss by up to the rate of UK corporation tax (19% for the period covered by IST 2022; 25% from 1 April 2023). The largest allowance in IST 2022 increased SCR coverage by nearly 16 percentage points, although most increases in coverage were significantly smaller. More comprehensive responses demonstrated how tax had been calculated as well as documenting the interaction with loss absorbing capacity of deferred tax and their post stress SCR.

- **Unexpired risk and inflation.** The NatCat scenarios did not incorporate the heightened geopolitical and economic risks, such as increased inflationary pressures that emerged after IST 2022 was developed. However, participants were asked to describe in broad terms how the results of each scenario would be affected by these heightened risks. Separately, any inflation to future claims, such as inflation consistent with PLA caused by the direct stresses in IST 2022, should be recognised as an increase in unexpired risk.

Only 26% of participants made any adjustment to reflect changes needed to assumptions about the profitability of unexpired risk. The largest adjustment represented about 20% of the loss caused by the direct stress. Few details were provided in Results and Basis of Preparation reports about the assessment of unexpired risk, and few participants discussed in any detail how the heightened risks could affect the scenarios, or compared them with the base case assumptions which formed the starting point for IST 2022.

We draw attention to the insights from our recent thematic review on the effects of claims inflation on general insurance claims. These were published in our letter on 20 October 2022 to the Chief Actuaries of general insurance firms and Lloyd's Managing Agents regulated by the PRA.¹⁵

Information supporting Solvency II adjustments

Information provided to the PRA about assumptions, data and methodology for assessing the gross and net losses generally did not extend to the above areas. For example, assumptions about risk-free interest rates used to discount loss cash flows and to calculate the risk margin, the availability of tax relief on the losses, and the consequences for the cost of future claim events were often not provided. Where participants made changes to unexpired risk following a stress, the adjustments were mainly to premiums and reinsurance recoveries.

¹⁵ <https://www.bankofengland.co.uk/prudential-regulation/letter/2022/october/insights-from-thematic-review>.

ANNEX 4: Reinsurance feedback

General comments

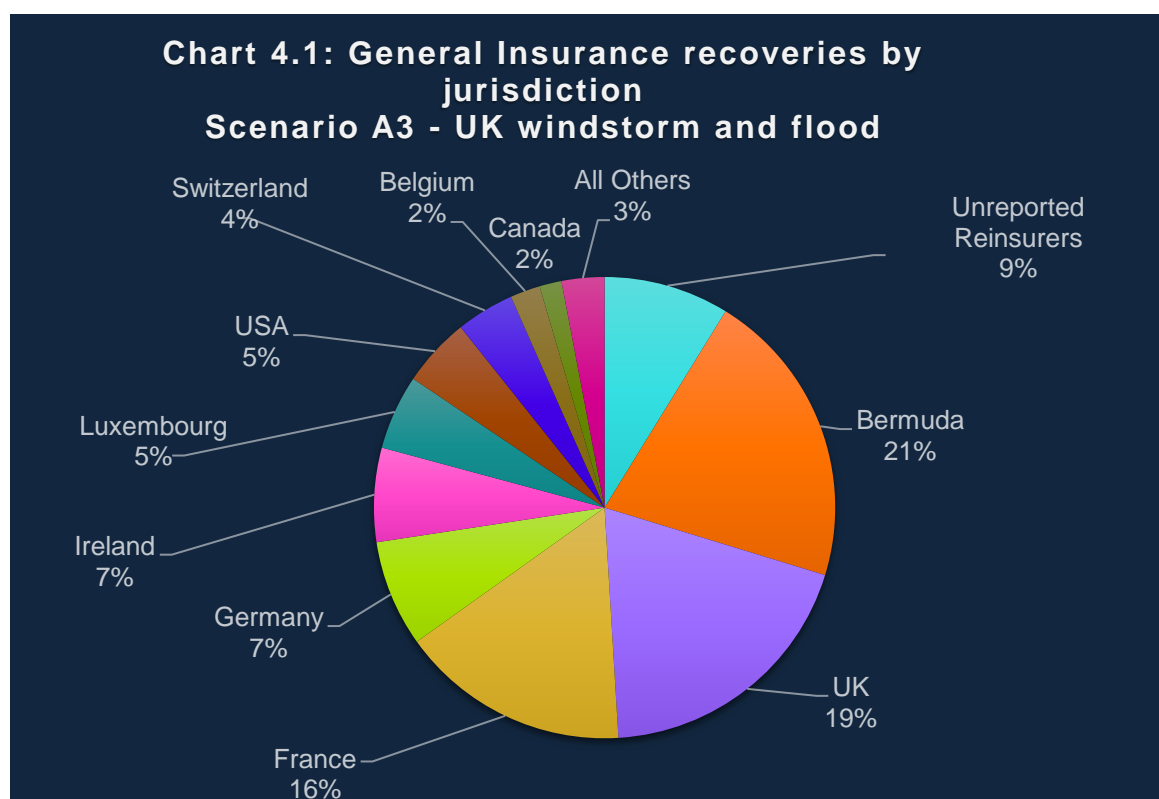
The IST exercise indicates that UK general insurers and UK life insurers with significant annuity business have a material dependency on the global reinsurance market. However, as we would expect, the level of reinsurance dependency varies materially by each participating entity, reflecting both the differing scales of losses that it is exposed to, and the differing reinsurance and capital strategies adopted.

General insurers in aggregate ceded more risk than they retain under the stressed scenarios. This is consistent with the observed historic trends of reinsurance protection strategies in the general insurance lines of business to manage low frequency high severity loss potentials.

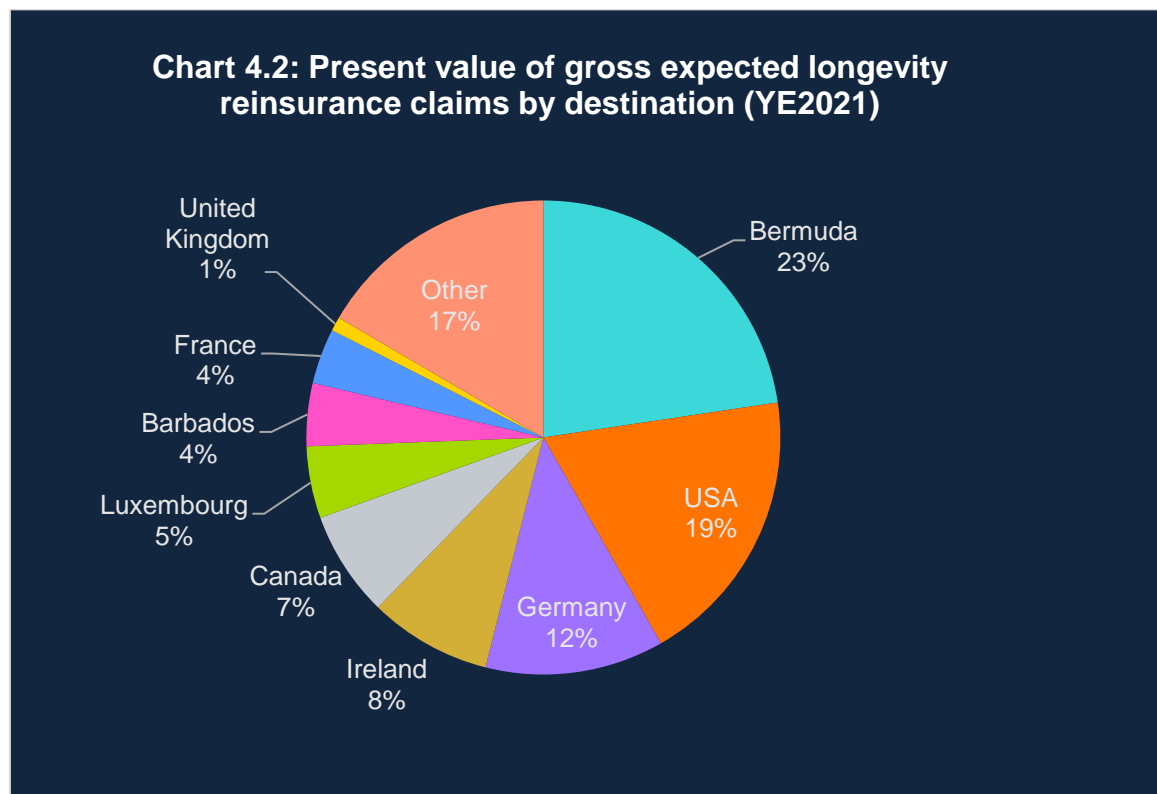
For life insurers, reinsurance is used to mitigate the impact of material losses arising from longevity.

Reinsurance market concentrations and financial strength

The results of this exercise suggest that the UK insurance sector is not financially reliant on any one reinsurer entity, reinsurer group, or third-country regulatory jurisdiction. Furthermore, SPVs are currently a minimal feature.



Sources: Firm submissions and PRA calculations.



Sources: Firm submissions and PRA calculations.

In addition, no immediate concerns have been identified regarding the financial security/stability of the reinsurance arrangements in place.

For general insurers, as expected, the use of working or standby collateralisation/ securitisation is a modest feature, so there is a material reliance on reinsurers' ongoing financial stability and the Financial Strength Ratings and assessments issued by rating agencies. Rating agencies' current opinion of the global reinsurance industry (for general insurance) is that it is, in the main, financially secure. While capital levels of key reinsurers remain generally strong, the solvency coverage ratios have reduced over recent years. Rating agencies' 2023 financial performance outlook for the industry ranges from stable to negative, with positive underwriting outlooks being counterbalanced by uncertainties in claims frequency and inflation, and asset valuation volatility. This reinforces the need for firms to monitor the ongoing financial and strategic stability and suitability of their reinsurance counterparties.

Scenario specific observations for general insurers

The nature and complexity of the responding reinsurance protections varied materially by each participating firm. These ranged from straightforward monoline proportional and non-proportional structures with clear coverage and recovery flows, to instances where the expected recoveries relied on the interplay of a range of both mono-line and multi-line/peril reinsurance protections, and protections shared with multiple reinsured entities. This reinforces the need for firms to fully understand the contractual and

recovery interdependency between their inwards contracts and between different reinsurance contracts, and to periodically review the accuracy of recovery assumptions, especially those where protection is shared with other legal entities.

NatCat scenario related reinsurance observations

For those participants who experienced material gross losses, it was common for the multiple events of each NatCat scenario to trigger the need to reinstate limits for lower layers of vertical 'Per Risk' and 'NatCat Event' reinsurance programmes. In some cases these lower layers were exhausted in full. However, full exhaustion of all reinsurance limits was not common, as the magnitude of losses was generally contained within the design of participants' reinsurance programmes. Consideration of additional post loss reinsurance purchasing was included within the proposed management actions.

Cyber underwriting scenario related reinsurance observations

Reinsurance erosion/exhaustion for the cyber underwriting scenarios presented a more mixed picture with the severity of the scenario parameters and magnitude of some of the gross loss estimates not always being contained within the extent of the non-proportional reinsurance structures. This feature was; however, mitigated by the presence of protection afforded by proportional reinsurance which was common in cyber lines of business.

These observations reinforce the need for firms to regularly review the efficacy of their reinsurance design criteria and protection availability in order to achieve their net of reinsurance risk appetites.

Implications for general insurers in the changing market conditions

In light of the current hardening of global reinsurance and retrocession markets, which is expected to continue into 2023 (particularly impacting property damage, business interruption, and speciality lines of business), it is possible that IST participants may, in future, retain higher levels of net loss relative to their gross losses than in the current IST 2022 NatCat and cyber underwriting scenario results.

This highlights the ongoing material financial reliance that UK firms have on the availability, contractual performance, and structural suitability of their reinsurance protections, along with the financial stability of their reinsurance counterparties, to mitigate their own risk of financial instability following material catastrophe losses.

This reinforces the need for firms to have robust and effective reinsurance management and governance procedures in place to manage counterparty concentrations and monitor the ongoing financial and strategic stability of their reinsurance counterparties.

We routinely monitor the conditions and trends of the global reinsurance market and the financial and strategic stability of key reinsurers. In response to the above findings, during 2023 we will undertake targeted supervisory investigations with selected firms to assess potential reinsurance risks to their financial and business model stability.