Insurance Capital Standard

Calibration document

(December 2024)

.

About the IAIS

The International Association of Insurance Supervisors (IAIS) is a voluntary membership organisation of insurance supervisors and regulators from more than 200 jurisdictions. The mission of the IAIS is to promote effective and globally consistent supervision of the insurance industry in order to develop and maintain fair, safe and stable insurance markets for the benefit and protection of policyholders and to contribute to global financial stability.

Established in 1994, the IAIS is the international standard-setting body responsible for developing principles, standards and other supporting material for the supervision of the insurance sector and assisting in their implementation. The IAIS also provides a forum for Members to share their experiences and understanding of insurance supervision and insurance markets.

The IAIS coordinates its work with other international financial policymakers and associations of supervisors or regulators, and assists in shaping financial systems globally. In particular, the IAIS is a member of the Financial Stability Board (FSB), member of the Standards Advisory Council of the International Accounting Standards Board (IASB), and partner in the Access to Insurance Initiative (A2ii). In recognition of its collective expertise, the IAIS also is routinely called upon by the G20 leaders and other international standard-setting bodies for input on insurance issues as well as on issues related to the regulation and supervision of the global financial sector.

For more information, please visit www.iaisweb.org and follow us on LinkedIn: IAIS – International Association of Insurance Supervisors.

International Association of Insurance Supervisors
c/o Bank for International Settlements
CH-4002 Basel
Switzerland
Tel: +41 61 280 8090

Contents

List of Acronyms

CDR (Cumulative Default Rate)

CEIOPS (Committee of European Insurance and Occupational Pensions Supervisors)

ComFrame (Common Framework for the Supervision of IAIGs)

EEA (European Economic Area)

GRET (Generally Recognised Expense Table)

GWP (Gross Written Premium)

IAIGs (Internationally Active Insurance Groups)

IAIS (International Association of Insurance Supervisors)

ICS (Insurance Capital Standard)

ICS RC (ICS Rating Category)

IRB approach (Basel Internal Ratings-Based approach)

LOT (Last Observed Term)

LGD (Loss Given Default)

NAD (Neutral Adjusted Dampener)

NDSR (Non-Default Spread Risk)

OTC (Over The Counter)

PD (Probability of Default)

PRNG (Pseudorandom Number Generator)

SPD (Stressed Probability of Default)

Tail-VaR (Tail-Value at Risk)

US (United States)

VaR (Value at Risk)

1 Background information

1.1 ICS and ComFrame

1. The Insurance Capital Standard (ICS) is a consolidated group-wide capital standard. It is a measure of capital adequacy for Internationally Active Insurance Groups (IAIGs) and constitutes the quantitative component of the Common Framework for the Supervision of IAIGs (ComFrame), which consists of both quantitative and qualitative supervisory requirements tailored to the complexity and international scope of IAIGs.

1.2 Objective of the calibration document

2. The objective of this document is to provide insight into the calibration of the individual risk charges of the ICS. It aligns with the public commitment made by the IAIS to prepare and release a calibration document for ICS risk charges, reflecting the IAIS's dedication to transparency and disclosure[1].
3. This document aims at presenting information in a manner that is both clear and impactful. In particular, the evolution of calibration over time (during Field Testing and then confidential reporting of the ICS) is described succinctly only if essential for the understanding of current calibrations. Also, when not explicitly mentioned in the text, all stress factors used for the calculation of ICS risk charges are listed in Annex, so this document can be read on a standalone basis.

1.3 Content of the calibration document

4. The present calibration document provides explanations on the calculation of the different ICS risk charges and their aggregation. Detailed information is made available for all risk modules within Insurance risks, Market risks, Credit risk and Operational risk, as well as for correlation matrices used for aggregating risk charges.
5. Because non-insurance risk charges essentially rely on sectoral requirements for which calibration was not performed by the IAIS, those risk charges have been excluded from the scope of this document.
6. The ICS treatment of tax has also been excluded from this document, as this item does not constitute a risk charge that relies on a calibration process.

[1] As exemplified in the IAIS Annual Conference 2021 Public Q&A Summary (here)

2 Insurance risks

2.1 Life insurance risks

2.1.1 Definition

7. Life risk charges are applicable to life business and similar to life health business and consist of the following five sub-risk charges.
   a. Mortality risk: risk of losses due to actual mortality rates higher than expected;
   b. Longevity risk: risk of losses due to actual mortality rates lower than expected;
   c. Morbidity/Disability risk: risk of losses due to unexpected changes in the level, trend or volatility of disability, sickness and morbidity rates;
   d. Lapse risk: risk of losses due to unexpected changes in the level or volatility of rates of policy lapses, terminations, renewals and surrenders;
   e. Expense risk: risk of losses due to unexpected changes in the incidence of expense incurred.

2.1.2 ICS Methodology

8. For each of the five sub-risks listed above, stress factors are applied to the parameters underpinning the calculation of current estimates, in order to generate stressed balance sheets in line with the ICS target criteria – a probability of occurrence of 0.5% over a 1-year time horizon.
9. The calculation of all sub-risk charges are based on the following geographical segmentation, with respect to the location where risks are written:
   a. EEA and Switzerland;
   b. US and Canada;
   c. China;
   d. Japan;
   e. Other developed markets; and
   f. Other emerging markets.
10. The five Life insurance sub-risks charges are aggregated with a correlation matrix; the correlation factors are based on expert judgement whether the corelation between two sub-risks is negative, negligible, low, medium or high.
11. For each of the five sub-risks, the risk charge is calculated both with and without the impact of management actions.
12. The design of Life risks was informed by Field Testing exercises from 2014 to 2019, confidential reporting exercises from 2020 to 2024, as well as public consultations on ICS in 2014, 2016 and 2018. The calibration of Life risks was supported by targeted data collections in 2016, 2018 2019 and 2022 (all risks), as well as 2015 and 2017 (Morbidity/disability risk).

2.1.3 Calibration of risks

13. To inform the calibration of Life risks, supplementary data collections were run in 2018, 2019 and 2022, together with the Field Testing / confidential reporting data collections. In the context of those supplementary Life data collections, Volunteer Groups were requested to provide data covering at least 10 consecutive years (in 2018 and 2019), and 13 consecutive years (in 2022).

2.1.3.1 Mortality risk

14. The calculation of the mortality risk charge is based on a scenario of general permanent increase in mortality rates.
15. Based on a review of existing risk-based supervisory frameworks, and after field testing different factors between 10% and 15%, the stress factor was provisionally set at 12.5% for all regions.
16. In 2018 and 2019, data were collected from IAIGs in order to inform a potential refinement of the calibration. Based on those data and on the assumption that the variable $\frac{A}{E} - 1$ (where A and E respectively denote actual and expected claims, due to all causes, incurred in each financial year) follows a normal distribution (for which observations are independent and identically distributed), the following 99.5th percentiles[2] were calculated for mortality rates:
    a. 6% for business written in Japan;
    b. 15% for business written in China; and
    c. 10% for business written in other developed markets.
17. Data for the Japanese market were considered sufficient evidence, with over 10 years of history; therefore, it was decided to set the stress factor for business written in Japan to 10% (including a prudence margin based on expert judgement). The appropriateness of that level was confirmed by data collected in 2022.
18. For business written in China, the 2019 and 2022 data collections provided evidence of a risk factor between 13% and 27%; the risk factor was therefore set to 15%.
19. For other developed markets, data collected in 2022 supported a 12.5% risk factor.
20. For US and Canada and other emerging markets, the lack of historical data provided in all data collections did not allow for an adjustment of the calibration. Therefore, based on expert judgement the stress factor was aligned with other developed markets (12.5%).
21. For EEA and Switzerland, 10 years of historical data collected through the 2019 data collection showed that a 12.5% risk factor was appropriate. Data collected in 2022 continue to support this conclusion.

2.1.3.2 Longevity risk

22. The calculation of the longevity risk charge is based on a scenario of a permanent decrease in mortality rates.
23. Based on results of data provided by IAIGs for the calibration exercise in 2016, a stress factor of 17.5% across all regions was specified[3] for the 2017 Field Testing. In the absence of any evidence that this level of stress is inappropriate, the 17.5% factor has remained unchanged since then.

2.1.3.3 Morbidity and Disability risk

24. For the calculation of the morbidity/disability risk charge, the business is split:
    a. By type of guarantee:

---

[2] In practice, the 99.5th percentiles were determined as 2.58 times the historical standard deviation calculated for the $\frac{A}{E} - 1$ variable.

[3] The stress factor was chosen in a way to cover implicitly the trend and volatility components of the longevity risk, since the choice was made not to include explicitly those components in the design. This approach was considered striking an appropriate balance between complexity and risk sensitivity.

i. Medical expenses (Category 1)
ii. Lump sum in case of a health event (Category 2)
iii. Short-term recurring payments (Category 3)
iv. Long-term recurring payments (Category 4)

b. By term of contract:
   i. Short-term (up to 5 years)
   ii. Long-term (more than 5 years)

resulting in eight segments (4 types of guarantee and for each type, 2 terms of contract).

25. For segments in categories 1 to 3, stress factors are applied either to inception / recovery rates (when those are explicitly used for the modelling of claim costs) or otherwise directly to the expected amount of future claims. For segments in category 4, stress factors are applicable to the assumptions underlying the calculation of future claims (inception rates and recovery rates).

26. The distinction between short-term and long-term contracts was introduced to reflect that claim amounts over a short period are likely more volatile than over a longer period.

27. All stresses are assumed to occur simultaneously, therefore risk charges for those four categories are added together.

2.1.3.3.1 Medical expenses (Category 1)

28. For short-term contracts, an initial calibration based on 10-year historical data provided by IAIGs was undertaken in 2015. The calibration methodology consisted of calculating, for a number of portfolios, the coefficient of variation (standard deviation divided by average) over time of the following ratios:
   a. number of claims[4] per insured people; and
   b. claim amounts to premiums.

29. The calculated coefficients of variation showed an important heterogeneity and averaged at 12.1% (ratio based on number counts) and 5.3% (ratio based on amounts). Based on those results, a figure of 8% was chosen to represent the typical coefficient of variation for Category 1 products. Under a Gaussian assumption, this 8% coefficient translated into a 21% stress factor (99.5 percentile), which was rounded down to 20%.

30. For long-term contracts, a calibration was done in 2017 based on an additional data collection from IAIGs, also covering 10 years of history. A 99.5% quantile was calculated based on the historical distribution of claims to gross written premiums. Under a Gaussian assumption, those data provided evidence of a risk factor of 7%. Finally, a margin for prudence was incorporated and an 8% stress factor was set.

2.1.3.3.2 Lump sum in case of a health event (Category 2)

31. For Category 2 short-term contracts, the same approach was applied as for Category 1 short-term contracts, based on data collected in 2015. Both sets of ratios showed evidence of an average coefficient of variation close to 8%. However, given the significant variability of those coefficients across portfolios (from 1% to 28%), some conservatism was introduced and a value

[4] In this section on Morbidity and Disability risk the term *claims* encompasses claims due to all causes incurred in a given financial year.

of 10% was chosen as a typical coefficient of variation, resulting in a 99.5% stress factor of 26%, rounded down to 25%.

32. For Category 2 long-term contracts, the same approach was applied as for Category 1 long-term contracts, based on data collected in 2017. This approach resulted in the choice of a 20% stress factor (30% based on number of policies, 19% based on expected claims).

33. An additional data analysis conducted in 2018 and 2022 on long-term Category 2 business written in Japan provided evidence supporting a risk factor of 15%.

2.1.3.3.3 Short-term recurring payments (Category 3)

34. For Category 3 short-term contracts, the same approach was applied as for Category 1 short-term contracts, based on data collected in 2015. The set of ratios based on the number of insured people showed a coefficient of variation slightly above 8% on average, and 4% for the set based on premiums. Given the high level of discrepancy across portfolios (between 0.7% and 20%, after exclusion of obvious outliers), a typical coefficient of variation was set at 7%, which translated into a stress factor of 18%, rounded up to 20%.

35. For Category 3 long-term contracts, the same approach was applied as for Category 1 long-term contracts, based on data collected in 2017. This approach resulted in setting a 12% stress factor (26% based on number of policies, 12% based on expected claims).

36. The data analyses run in 2018 and 2022 showed evidence that the 99.5% quantile for long-term Category 3 business in Japan was slightly below 10%. Therefore, it was decided to set the stress factor for business written in Japan to 10%.

2.1.3.3.4 Long-term recurring payments (Category 4)

37. For short-term contracts, the calibration data collected was limited: only one Volunteer Group provided data covering at least 10 consecutive years in 2019, and none in 2022. Therefore, stresses for short-term contracts were determined by reference to Solvency II, which features the same target criteria (99.5% VaR over a one-year time horizon).

38. For long-term contracts, the same stress factors were chosen as a starting point, and a 20% haircut, based on expert judgement, was applied to the inception rate stress factor to account for a lower volatility of claims over the long run.

2.1.3.4 Lapse risk

39. The calculation of the lapse risk charge involves three different scenarios:
    a. A permanent increase in future lapse rates (level and trend, up);
    b. A permanent decrease in future lapse rates (level and trend, down); and
    c. An immediate surrender of a fraction of the in-force policies.

40. For the two scenarios of the level and trend component, an initial placeholder calibration (40% relative increase / decrease in the current estimate lapse rates) was determined based on expert judgement. Based on a Gaussian assumption for the distribution of the variable $\frac{A}{E} - 1$ (ratio of actual to expected number of lapses incurred over the financial year), 10-year historical data submitted by IAIGs in 2018 provided evidence that the 99.5th percentile of lapse rates for business written in Japan should be between 12% and 20%; this evidence was confirmed by the data collected in 2019. Therefore, the stress factor for the level and trend component for business written in Japan was revised to 20%. The data collected in 2019 and 2022 confirmed the appropriateness of the stress factors for Europe, Japan, China and other developed markets. No sufficient data was obtained for other regions.

41. The mass lapse scenario stress factors are 30% (retail policies) and 50% (non-retail). These were determined based on expert judgement after a review of various jurisdictional solvency regimes including those from Solvency II, South Africa, Australia, Canada, Singapore and Japan.
42. Depending on the portfolio structure, either the mass lapse or the level and trend scenario could be the relevant 0.5% probability scenario for a given IAIG. Therefore, the maximum between those two scenarios is retained as the lapse risk charge. For the same reason, the higher of the level and trend up and level and trend down results is retained as the level and trend component.

2.1.3.5 Expense risk

43. The calculation of the expense risk charge involves two simultaneous scenarios:
    a. An increase in the unit expense amount by a factor x;
    b. An increase in the level of inflation of expenses by a factor y.
44. An initial placeholder calibration of those two scenarios was chosen by expert judgement and a review of this calibration was undertaken in 2017. This took into account:
    a. The responses to the 2016 ICS public consultation;
    b. 9 to 12-year historical data submitted by IAIGs in 2016; and
    c. The Generally Recognised Expense Table (GRET) study published by the Society of Actuaries in the US, based on data from 2008 to 2014.
45. The review concluded that:
    a. A permanent 3% stress on inflation for China and emerging markets is not realistic, and should be graded down over time;
    b. The order of magnitude of the x factor is 10%; and
    c. The global level of 99.5% stress (unit expense + inflation) in the US should be approximately 16%.
46. In addition, a review based on Field Testing data and conducted in 2018 showed that a 6% factor for unit expense risk in Japan was appropriate.
47. Based on those considerations, it was decided to introduce a downgrading of the inflation stress after year 10 for Other developed markets, China and Other emerging markets. Other factors were considered globally appropriate. Data collected in 2022 did not provide evidence of calibration inappropriateness.

2.2 Non-Life risk

2.2.1 Definition

48. Non-Life risks capital requirement is intended to ensure that IAIG's hold sufficient capital to protect against the 99.5th percentile of non-life losses over a one-year time horizon. The non-life requirement is split between the risk associated with timing, frequency and severity of future insured events (premium risk) and the risk associated with future payments on insured events that have already occurred (claims reserve risk).

2.2.2 ICS methodology

2.2.2.1 Risks and exposures

49. All risk posed by insured events that occur during the one-year time horizon (including on policies that are not recognized on the ICS balance sheet) is included within premium risk. Risk posed

by running off insured losses beyond the one-year time horizon is excluded from the ICS. While the ICS allows for a range of other methodologies, this calibration exercise assumes that premium liabilities are valued using an unearned premium allocation approach (see 2.2.3.1). Risk that profits on future policies (including due to lapse, cancellation and changes in premium liability methodology) differs from that currently recognised on the ICS balance sheet is assumed to be zero.

<table>
<tr><th colspan="2" rowspan="2">Example: ICS Reported @ 31 Dec, 2024</th><th colspan="4">Development Year</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4+</th></tr>
<tr><td rowspan="5">Year that Event occurs</td><td>Prior</td><td colspan="3" rowspan="2">Known values --> No risk</td><td>Reserve Risk</td></tr>
<tr><td>2023</td><td>Reserve Risk</td></tr>
<tr><td>2024</td><td></td><td>Reserve Risk</td><td colspan="2" rowspan="2">Beyond One Year Horizon --> Excluded from ICS</td></tr>
<tr><td>2025</td><td>Premium Risk</td><td></td></tr>
<tr><td>2026</td><td colspan="4">Risk assumed to be zero</td></tr>
</table>

50. Future events that are included in the ICS catastrophe risk component (e.g. natural catastrophe) are excluded but all other causes of losses (including catastrophic events that do not have a separate capital requirement) are included in premium risk. The risks associated with catastrophic events that have already occurred (including latent liability events) are included within reserve risk.

51. The ICS Non-Life capital requirement uses a factor-based approach where a factor for each insurance segment is multiplied by an exposure. The exposure base for premium risk is the expected premium to be earned during the one-year time horizon. As an approximation, IAIG's can use the net written premium from the prior year. The exposure base for reserve risk is the net current claims estimate. This is the discounted future cashflows on insurance claims that have already occurred including expenses and net of the impact of reinsurance.

2.2.2.2 Segmentation

52. To make the most use of existing reporting, ICS segments are based on the same jurisdictional lines of business as used in reporting to local supervisors. For purposes of diversification, segments are grouped into risk category (Liability-like, Property-like, Motor-like, Other) and region (EEA and Switzerland, US and Canada, China, Japan, Other Developed Markets and Other Emerging Markets).

2.2.2.3 Aggregation/Diversification

53. Diversification is applied between Premium and Claims Reserve risks, within and between each of the four IAIS categories, and between geographical regions. No geographic diversification is applied within a single geographic region.

54. The multi-step aggregation is performed in the following order:

    a. The first step of aggregation is to combine each ICS segment's Premium risk and Claims Reserve risk charges, applying a 25% correlation between the Premium and Claims Reserve risk charges. Mortgage business and credit business are added across all regions and then included in the calculation of Real Estate risk and Credit risk, respectively.

    b. The second step of aggregation is within categories, where the following correlation matrix is applied across segments of a given category:

Categories	Correlation factor between segments of the category
Liability-like	50%
Motor-like	75%
Property-like	50%
Other	25%

c. The third step of aggregation is within a region, where a correlation matrix is applied to each of the four aggregated IAIS categories' risk charge (applying a 50% correlation between ICS categories).

d. The fourth step of aggregation is across regions, where a correlation matrix is applied to each region's total risk charge (applying a 25% correlation between regions).

2.2.3 Calibration

2.2.3.1 Data and assumptions

55. The factors were calculated with assumption that:

    a. the only changes to the balance sheet will be from premiums received during the one-year time horizon will be from losses paid on existing policies and from changes to the estimates the non-life current estimate.

    b. All other assets and liabilities (including the margin over the non-life current estimate), discount rates and exchange rates are constant.

    c. All insurers use an unearned premium (aka premium allocation approach) for calculating premium liabilities with an expected combined ratio of 100%.

56. Factors were calculated for any segment where data was available for at least three separate insurers. For each insurer, a minimum of 8 years of data was required. (Typical reported triangles include 10 years of data; for US segments, Schedule P's were combined to produce 20 years of loss history.) Data from "minor lines" (i.e. when a segment is less than 1% of an insurer's portfolio) was excluded as it was often not representative of the typical risk profile for IAIG's within that segment.

57. Factors were calculated by fitting a lognormal distribution to data from loss triangles. Data points within each segment were centred on a common mean and assumed to have the same standard deviation.

2.2.3.2 Sources

58. Where possible, data that has been collected in consistent and complete manner as part of a local reporting requirements was used. Data was provided by the Office of the Superintendent of Financial Institutions (Canada), Financial Services Agency (Japan), Financial Services Commission (Korea), Monetary Authority of Singapore, Prudential Regulatory Authority (UK) and National Association of Insurance Commissioners (USA). Further requests were made to volunteer IAIG's during the ICS Field Testing process to allow for calibration of factors for jurisdictions where supervisors have only recently begun to collect such data.

2.2.3.3 Premium risk

59. For premium risk, a lognormal distribution was fit to the ultimate loss ratio (as evaluated after one year) for each segment. The factor was the 99.5th percentile of the distribution less the expected value. Each loss ratio was assumed to be independent and have an identical standard deviation. The mean loss ratio for each insurer is assumed to be unique: loss ratios were recentred on the segment (as opposed to insurer) mean before the distribution was fit. Where the ultimate loss ratio after one year was not available, the final ultimate loss ratio was used. For jurisdictions that were unable to separately report catastrophic and non-catastrophic loss, the distribution was fit on the total data and the resulting factor was reduced by 10%. While the historical data is undiscounted, the impact on the ICS balance sheet of a loss is discounted. Therefore, factors were reduced by a factor calculated using the payment pattern implied by triangles for each segment and the IAIS discount curves.

2.2.3.4 Claims reserve risk

60. For claims reserve risk, a lognormal distribution was fit to the distribution of reserve development for each segment's loss triangles. Reserve development is defined as the change in the estimate of ultimate loss as a percentage of the outstanding reserve at the beginning of the year. Each year's development, for all insurers within a segment, was assumed to be independent and identically distributed. The mean reserve development for each segment was recentred on 1 (i.e. reserves at the beginning of the year are assumed to be an accurate estimate of the expected ultimate loss). To allow for the most use of the available triangles, development was only calculated across four accident years. Analysis indicated that one-year development was distorted by the reserving cycle and so factors were calculated using the 99th percentile of two-year development.

2.2.3.5 Selection of factors

61. To ensure robustness, results were calculated and compared using a variety of statistical methods. To avoid impact of outliers created by reporting issues, final parameters for segments with sufficient data were estimated using the 50th and 90th percentiles of the segment's distribution. All factors above 20% were rounded to the nearest 5%. All factors below 20% were rounded to the nearest 2.5% with a floor of 7.5%. An addition, using expert judgment, was made to the reserve risk factors for long-tailed lines to reflect potential for latent liability risk beyond that observed in the historical data.

62. For segments without calibration data, a mapping approach was used to align them to the most similar segment for which factors were calibrated. Additionally, expert judgment was used to determine factors for the following segments:

Region	Segment	Updated		Original Mapping	
		Prem	Res	Prem	Res
Australia and New Zealand	Other type A	25%	20%	30%	20%
	Other type B	35%	35%	35%	25%
	Consumer Credit	35%	15%	35%	25%

	Motor damage and liability	25%	15%	25%	20%
Hong Kong	Fire and Property damage	35%	20%	35%	30%
	General liability	45%	26%	45%	36%
	Treaty reinsurance	45%	25%	45%	35%

2.2.3.6 Aggregation/Diversification

63. The correlation factors applied within the Non-Life risk component are based on expert judgement and aim at striking the right balance between simplicity and accuracy by appropriately capturing any tail correlation and non-linear dependencies between subcategories of Non-Life risks.

2.3 Catastrophe risk

2.3.1 Definition

64. Catastrophe risk covers risks associated with claims events that have yet to occur, and are risks associated with low frequency/high severity events, often arising from an aggregation of multiple claims originating from a single source. Catastrophe risk affects life and non-life business.

2.3.2 ICS methodology

65. Catastrophe risk is segmented at the risk/peril level. In the ICS, peril covers both naturally occurring perils (natural catastrophe) and man-made perils/scenarios (other catastrophe) and their consequences. It considers all losses arising as a consequence of events occurring at any point in time in the next 12 months and should take into account expected business volumes including expected new business to be written during the next 12 months[5].
66. The segmentation is the following:
67. Natural catastrophe
    a. Tropical cyclone, hurricane, typhoon
    b. Extra-tropical windstorm / winter-storm
    c. Earthquake
        i. Other material natural perils such as:
        ii. Flood
        iii. Tornado, hail, convective storms
        iv. Other risks
68. Other catastrophe scenarios
    a. Terrorist attack

[5] The catastrophe risk covers not only the main peril (e.g. windstorm, earthquake), but also the secondary perils associated with the primary peril. For example, storm surge as well as demand surge or loss amplification should be associated with tropical cyclone as appropriate. Fire following earthquake, sprinkler leakage and demand surge or loss amplification should be associated with earthquake as appropriate.

b. Pandemic
c. Credit and surety

2.3.3 Calibration

2.3.3.1 Use of natural catastrophe models as part of the standard method

69. For the risk assessment of natural catastrophe, the ICS allows the use of stochastic catastrophe models (vendor or proprietary) to calculate the loss amounts resulting from natural catastrophe events.
70. During the development of the ICS, loss amounts related to natural catastrophe were requested for different confidence levels and different measures (VaR and Tail-VaR). Volunteer IAIGs were also asked to report qualitative information regarding the catastrophe model used as well as how the model was used.
71. Allowing the use of natural catastrophe models as part of the standard method is perceived as an appropriate approach leveraging on scientific risk assessment methodologies, embedded in such models, and aligning the risk assessment with generally recognised market practices.
72. To ensure the appropriateness of the models used, the ICS embeds safeguards about the quality of the model themselves but also about how those are used by IAIGs.

2.3.3.2 Man-made catastrophe scenarios

73. The man-made catastrophe scenarios have been defined, in the context of the standard method, to support the measure the 99.5% VaR over one year for each individual IAIG.
74. This involves a high degree of expert judgement and some simplifications acceptable for a standard method, focusing on achieving an appropriate level of comparability and accuracy while preserving a desirable level of simplicity and practicality. The Lloyds Realistic Disaster Scenarios[6] were used as a basis to derive the ones embedded in the ICS.
75. Also, one should note that the man-made catastrophe scenarios included for the purpose of the ICS have been selected based on their materiality. To do so, 2015 Field Testing requested loss amounts related to associated with natural catastrophes and the following man-made scenarios:
    a. a terrorist attack scenario;
    b. a liability catastrophe scenario;
    c. a pandemic scenario;
    d. a marine collision scenario;
    e. an aviation collision scenario; and
    f. a credit and surety scenario.
76. The obtained breakdown of total Catastrophe risk charges in 2015 Field Testing results helped refine and simplify the methodology, as the marine and aviation collision scenarios proved not to be material compared to other scenarios.

[6] Realistic Disaster Scenarios - Lloyd's (lloyds.com)

Perils	Percentage of Total net loss as reported in 2015 Field Testing
Natural catastrophes	40.3%
Liability catastrophe	31.0%
Pandemic	14.8%
Terrorism	5.6%
Credit and surety	5.4%
Marine	1.6%
Aviation	1.3%

2.3.3.3 Diversification within Catastrophe risks

77. The contribution to the Catastrophe risk charge and ultimately to the ICS capital requirement from other Catastrophe components of the risk charge are considerably reduced by the effect of diversification.
78. For the purpose of calculating the Catastrophe risk charge, the other catastrophe scenarios are assumed to be mutually independent and independent of the natural catastrophe perils. Consequently, the total ICS Catastrophe risk charge is calculated as follows:

$$ICS_{Cat} = \sqrt{ICS_{NatCat}^2 + ICS_{Terror}^2 + ICS_{Pand}^2 + ICS_{Credit}^2}$$

3 Market risks

3.1 Interest rate risk

3.1.1 Definition

79. Interest rate risk is defined as the risk of adverse change in the value of capital resources due to unexpected changes in the level or volatility of interest rates. It is calculated as the aggregate of gains or losses under a set of scenarios, arising from independent sources, stressing the level and shape of the yield curve.

3.1.2 ICS methodology

80. In the ICS, interest rate risk is assessed by applying stresses on a per currency basis. The stresses are combined to determine the final cross-currencies capital requirement using high level assumptions about the linear correlations between currencies and, within a currency, between individual stress scenarios.
81. At the currency level, the stress scenarios stem from a Dynamic Nelson Siegel (DNS)[7] modelling simplified in two ways: 1) the specification of the model commands the K matrix which restricts the mean-reversion behaviour to be diagonal; 2) when calibrating stress scenarios from the model output, an approach similar to a principal-component-analysis reduces the number of individual stress scenarios.
82. The second simplification results in three individual scenarios, one representing the mean-reversion property of the DNS approach accompanied by a set of two symmetric scenarios.
83. The application of the stress scenarios remains aligned with the three-segment approach used for construction of the risk-free yield curve: scenario results are applied only on the first segment of the curve. The grading of the stresses between the end of the first segment and the start of the third segment relies on the automatic grading that is part of the Smith-Wilson method used to interpolate and extrapolate yield curves in between and outside of the point estimates. The magnitude of the level stress on the third segment has been set at 10% based on expert judgment and is capped at the maximum annual change described in the three-segments valuation specifications (15 bps).
84. The Interest Rate risk charge is calculated as:

$$max\left(0, \sum_i MR_i + \mathrm{VaR}_{99.5}\left(\sum_i LT_i\right)\right)$$

where:

- i is an index over all currencies in which the IAIG is exposed to Interest Rate risk;
- MR_i is the result of the mean reversion scenario for currency i; and
- LT_i is a random variable encompassing the results of the level up and level down scenarios for currency i.

85. For currency i, LT_i is defined as:

[7] As described in the article Diebold, F.X. and Li C (2006). “Forecasting the Term Structure of Government Bond Yields”. Journal of Econometrics, 130, 337-364

$$\frac{1}{N^{-1}(0.995)} \times (LU_i \max(X_i, 0) - LD_i \min(X_i, 0))$$

where:

- $N^{-1}(0.995)$ is the 99.5% quantile of the standardised normal distribution;
- LU_i and LD_i are the results of the level up and level down scenarios respectively; and
- X_i is a random variable following a standardised normal distribution such that for any $i \neq j$, $corr(X_i, X_j) = 0.75$.

86. Because there is no simple closed form solution to obtain the aggregate requirement, the requirement is calculated using direct simulation. The simulation algorithm is based on a large number of scenarios using random variables $\{X_i\}$ with the above correlation structure, and for each scenario calculates the quantity $\sum_i LT_i$. The aggregate requirement is the sum of all mean reversion losses and the 99.5th percentile of the level sum.

3.1.3 Calibration

87. For each currency, calibrating the stresses is based on determining the optimum parameters for the DNS model. This optimisation is performed by formulating the time series of the DNS parameter as a state space model and using the Kalman Filter technique[8] to find the set of parameters ($\kappa_{11}, \kappa_{22}, \kappa_{33}, \theta_1, \theta_2, \theta_3, \sigma_{11}, \sigma_{21}, \sigma_{22}, \sigma_{31}, \sigma_{32}, \sigma_{33}$) which maximise the log-likelihood.
88. The dataset used for this calibration is made of weekly interest rate observations starting at 1 January 2010 up to the relevant date of the interest rate curve. Maturities used for the calibration are (in years) 1,2,3,4,5,6,7,8,9,10,20,30 to the extent available (eg if the Last Observable Term is at year 10, then no data for years 20 and 30 are used). For each successive calibration, the starting point of the optimisation process is the optimum set of parameters found the previous year. The initial calibration was performed assuming no random component in the model.
89. No filtering adjustment is applied to the raw dataset to derive the calibration. The weekly observations are transformed into zero-coupon spot rates, using the same methodology as for the risk-free rate curve – i.e. including a credit risk adjustment of 10 basis points when the observed instruments are not considered risk-free, eg government bonds.
90. Under the Dynamic Nelson-Siegel model, the yield curve at time t is described in closed form as a linear combination of a level curve (L_t), a slope curve (S_t), and a curvature curve (C_t):

$$y_t(\tau) = L_t + S_t\left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau}\right) + C_t\left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau}\right)$$

91. The dynamic of the change in the yield curve - restricted to model definitions where mean-reversion matrix is diagonal[9] - is described by the following transition equation:

[8] See for example, Kalman, R.E. (1960). "A new approach to Linear Filtering and Prediction Problems". Journal of Basic Engineering. 82 (1): 35-45

[9] A fully flexible model with cross terms in the mean reversion factors (i.e. with non-diagonal elements in the K matrix) was also tested, without much difference.

$$\begin{pmatrix} dL_t \\ dS_t \\ dC_t \end{pmatrix} = \begin{pmatrix} \kappa_{11} & 0 & 0 \\ 0 & \kappa_{22} & 0 \\ 0 & 0 & \kappa_{33} \end{pmatrix} \left[\begin{pmatrix} \theta_1 \\ \theta_2 \\ \theta_3 \end{pmatrix} - \begin{pmatrix} L_t \\ S_t \\ C_t \end{pmatrix} \right] dt + \begin{pmatrix} \sigma_{11} & 0 & 0 \\ \sigma_{21} & \sigma_{22} & 0 \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{pmatrix} \begin{pmatrix} dW_t^L \\ dW_t^S \\ dW_t^C \end{pmatrix}$$

92. From this model specification, the DNS shocks are computed using the following algorithm.

1) Fit *L*, *S* and *C* to the discrete year-end data points using least squares. That is, choose L, S and C so that the sum of the squares of the difference between L*Level Curve + S*Slope Curve + C*Curvature Curve at the terms for which there are data points, and the data points themselves, is minimised. This initial vector (L, S, C) is referred to as V_0.

2) The mean reversion shock, expressed as a (L, S, C) vector is:

$$(I - e^{-K})(\theta - V_0)$$

where I is the 3 x 3 identity matrix. This linear combination of the DNS curves gets added to the year-end rates.

3) One set of shocks that could be placed under the square root, expressed as (L, S, C) vectors, consists of the columns of the square root of the conditional covariance matrix (using $\odot$ as the Hadamard product operator):

$$M = \sqrt{(\Sigma\Sigma^T) \odot \left(\frac{1 - e^{-(K_i + K_j)}}{K_i + K_j} \right)_{ij}}$$

multiplied by the normal percentile $N^{-1}(0.995)$, where:

$$K = \begin{pmatrix} K_1 & \square & \square \\ \square & K_2 & \square \\ \square & \square & K_3 \end{pmatrix}$$

4) In order to reduce the workload on the insurers and keep this method comparable to the principal components approach used previously, a principal components-type analysis on the three shocks available is performed and the most significant shock is kept[10]. Let:

$$N = \begin{pmatrix} LOT & \square & \square \\ \square & a & \square \\ \square & \square & b \end{pmatrix} M$$

where:

LOT = Last Observed Term (eg 30 for USD) $a = \sum_{\tau=1}^{LOT} \frac{1 - e^{-\lambda\tau}}{\lambda\tau}, b = \sum_{\tau=1}^{LOT} \left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau} \right)$

Diagonalise the matrix $N^T N$, and let e_1 be the eigenvector of $N^T N$ (with $\|e_1\| = 1$) that have the largest eigenvalue (i.e. the two eigenvectors with the lowest eigenvalues are discarded). The remaining shock is defined by Me_1.

5) The final shock is defined by $Level\ shock = N^{-1}(0.995) * Me_1$.

[10] This shock account for around 95% of the requirements.

6) The actual shocked curves are equal to the year-end curve plus or minus the linear combination of DNS curves, with coefficients taken from the components of the vector $Level\ shock$. For example, if Level shock is equal to:

$$\begin{pmatrix} 0.03 \\ 0.002 \\ 0.01 \end{pmatrix}$$

then the corresponding shocked curves are:

$$\text{Year-end curve} \pm N^{-1}(0.995) * (0.03\ \text{Level Curve} + 0.002\ \text{Slope Curve} + 0.01\ \text{Curvature Curve})$$

93. IAIGs operating in multiple jurisdictions are exposed to interest rate risk in more than one currency. The cross-currency aggregation is based on modelling the full joint distribution of the interest rate risk level random variables across currencies with a 75% pairwise linear correlation assumption between currencies. In times of crisis, spikes in interest rates are observed to be significantly correlated between currencies whereas they are not observed to be fully correlated in normal conditions, which, on a simplified scale of [0%, 25%, 50%, 75%, 100%] is best represented by 75%. To limit the complexity of the model, the per currency scenario assessment is limited to the 7 most material currencies, representing a trade-off between accuracy and simplicity.
94. During the monitoring period, 20,000 realisations of the multivariate correlated observations were used to evaluate the percentile of the Level aggregate. Using more simulations, e.g. 30,000, was also tested without a discernible increase in the simulation result accuracy but with a significant impact on the reporting template size. Correlated observations were obtained by transforming independent realisations of the normal law using the Cholesky decomposition[11] of the correlation structure. Independent realisations of the normal distribution were obtained using the Mersenne Twister pseudorandom number generator. [12]

[11] See for example, Lloyd N.Tefethen and David Bau. Numerical Linear Algebra

[12] See for example, Matsumoto, M. and Nishimura T. (1998). "Mersenne twister: a 623-dimensionally equidistributed uniform pseudo-random generator". ACM Transactions on Modelling and Computer Simulation 8 (1): 3-30.

	Correlation structure						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[1]	100%	75%	75%	75%	75%	75%	75%
[2]	75%	100%	75%	75%	75%	75%	75%
[3]	75%	75%	100%	75%	75%	75%	75%
[4]	75%	75%	75%	100%	75%	75%	75%
[5]	75%	75%	75%	75%	100%	75%	75%
[6]	75%	75%	75%	75%	75%	100%	75%
[7]	75%	75%	75%	75%	75%	75%	100%

	Cholesky factorization of the covariance matrix						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[1]	100%	0%	0%	0%	0%	0%	0%
[2]	75%	66.1%	0%	0%	0%	0%	0%
[3]	75%	28.3%	59.8%	0%	0%	0%	0%
[4]	75%	28.3%	17.9%	57.0%	0%	0%	0%
[5]	75%	28.3%	17.9%	13.2%	55.5%	0%	0%
[6]	75%	28.3%	17.9%	13.2%	10.4%	54.5%	0%
[7]	75%	28.3%	17.9%	13.2%	10.4%	8.6%	53.8%

3.2 Non-Default Spread risk

3.2.1 Definition

95. Non-default Spread Risk (NDSR) aims to capture unexpected changes in the level or volatility of spreads over the risk-free interest rate term structure, excluding the default component which is captured in Credit risk.

3.2.2 ICS methodology

96. NDSR charge is calculated as a relative bi-directional stress applied to both assets and liabilities. The NDSR charge is calculated as the maximum of an upward and downward stress, subject to a floor of zero.
97. All liabilities sensitive to changes in spreads are taken into account in the calculation of the NDSR charge, with the exception of financial instruments issued by the IAIG that qualify as capital resources.
98. All assets that contribute to the calculation of the spread adjustments for valuation purposes, are taken into account in the calculation of the NDSR charge, with the exception of sovereign assets.
99. The upward and downward stresses used for the calculation of the NDSR charge are a relative stress of -75% and +75% of spreads at each maturity up to the Last Observable Term (LOT).

3.2.3 *Calibration*

3.2.3.1 Magnitude of stress

100. Initially, the NDSR charge was set as an absolute bi-directional shock (up/down) to the balance sheet affecting both assets and liabilities, capped by a relative limit. The assumption made in the calibration was considering half of the observed spreads were not implied by default losses and should therefore be taken into account in the NDSR charge.

101. The results of the 2018 Field testing exercise showed unjustified discrepancies between NDSR charges for different currencies, which were driven by the underlying differences in the spread levels for the different currencies. Based on expert judgement[13] the NDSR charge was subsequently lowered, assuming that only a quarter of the spread should be used for the NDSR charge calibration.

102. The calibration work was performed using historical data. The Spreads of Markit Corporate bond indices (iBoxx), with the following date ranges of the input data were considered:

    a. EUR: 01/06/2004 -31/12/2016

    b. GBP: 02/01/2003 -29/12/2017

    c. USD: 04/01/1999 -29/12/2017

    Based on that data using rolling averages, a historical 1-year 99.5% VaR was calculated. The calibration resulted in a single stress in basis points for each credit rating, but did not depend on for example currency or maturity. This calibration of the absolute values was the starting point for the re-calibration when the switch to the relative approach for NDSR was made due to the changes in the discounting approach (using maturity dependent spread adjustments instead of a flat spread adjustment).

103. In 2022, the NDSR charge was adjusted to a relative bi-directional stress to reflect the dynamics of the term-structure approach introduced for Market Adjusted Valuation. The relative stress was calibrated to 75% based on the calibration work done earlier as described in 102. The re-calibration to a relative stress was done in a way such that the NDSR charges would be comparable to the NDSR charges of the previous absolute methodology. The decision to calibrate the relative stress to a single value was based on the granularity of available data (eg with respect to currencies, maturities and credit ratings) and accompanied with expert judgement to strike the balance between accuracy and complexity.

3.2.3.2 Caps and floors

104. The relative stress approach can lead to very low stresses in low spread environments and very high stresses in high spread environment. To avoid a misestimation of the risk by a pure relative approach, a floor of 40 basis points (bps) and a cap of 150bps for spread movements for the up-shock were introduced.

105. Calibration was conducted based on time series (01/01/2010-30/06/2023) of spread data available for EUR, GBP and USD determining the 99.5% and the 0.5% quantiles of spread movements. To keep the balance between accuracy, the limited availability of granular spread data and complexity of the model, a single value for all maturities, currencies and credit ratings

[13] Various studies came to very different results to the proportion of the spread that is attributable to default. Eg. “The Components of Corporate Credit Spreads: Default, Recovery, Tax, Jumps, Liquidity, and Market Factors” state numbers as low as 5%, while “Dissecting Corporate Bonds and CDS Spreads” provides numbers as high as 47%. In addition, the proportion also seems to change strongly over time. “Default risk in corporate yield spreads” states that for some time periods it can even reach 73.79% for Baa bonds.

was implemented. This approach was also supported by analysis indicating that results would not substantially differ with a more granular approach for most currencies.

3.3 Equity risk

3.3.1 *Definition*

106. Equity risk is the risk of adverse change in the value of capital resources due to unexpected fluctuations in the level or volatility of market prices of equities.

3.3.2 *ICS methodology*

107. The Equity risk charge calculation involves:

108. A level stress for the following six equity segments:

a. Listed equity in developed markets (other than infrastructure);

b. Infrastructure equity in developed markets;

c. Listed equity in emerging markets (other than infrastructure);

d. Infrastructure equity in emerging markets;

e. Hybrid debt / preference shares;

f. Other equity.

109. A volatility stress.

110. Segments i., iii. and vi. are subject to a Neutral Adjusted Dampener (NAD) as described in section 3.3.3.6.

111. In terms of aggregation, equities in each of the six segments are first subject to a separate stress. The results of those stresses, i. and ii. under 'Equity in developed markets', iii. and iv. in 'Equity in emerging markets', 'Hybrid debt/preference shares', and 'Other equity' are aggregated using a correlation matrix. The result of the volatility stress is added to the aggregate result of the level scenarios.

3.3.3 *Calibration*

3.3.3.1 Level stress – listed equity (segments i. and iii.)

3.3.3.1.1 Methodology

112. The stress factors have been determined as the average result of the four methods described below:

Method 1: one-year rolling window

The inputs to Method 1 are the annual returns y_i of an index price P_i observed on a daily basis:

$$y_i = \frac{P_i - P_{i-365}}{P_{i-365}}$$

The 99.5% VaR of the price process is taken equal to the non-parametric 0.5% percentile of the series of y_i.

Method 2: geometric Brownian motion

The inputs to Method 2 are the log-returns y_i of an index price P_i observed on a daily basis:

$$y_i = \ln \frac{P_i}{P_{i-1}}$$

The yearly drift and volatility of the geometric Brownian motion that prices are assumed to follow are estimated as:

$$m = 260 \,.\, \mu$$

$$s = \sqrt{260 \,.\, v}$$

Where μ and v denotes the empirical average and variance of the series of y_i.

The 99.5% VaR of the price process is then determined as $exp(Y_{0.5\%}) - 1$, where $Y_{0.5\%}$ is the 0.5% percentile of a normal distribution of mean $m - \frac{s^2}{2}$ and standard deviation s.

Method 3: log-normal distribution of annual returns

The inputs to Method 3 are the log-returns y_i of an index price P_i observed on an annual basis:

$$y_i = \ln \frac{P_i}{P_{i-1}}$$

The 99.5% VaR of log-returns $Y_{0.5\%}$ is calculated as the 0.5% percentile of a normal distribution of mean m and standard deviation s, where m and s denote the empirical average and standard deviation of the series of y_i.

The 99.5% VaR of the price process is then determined as $exp(Y_{0.5\%}) - 1$.

Method 4: simulation based on observed monthly returns

The inputs to Method 4 are the log-returns y_i of an index price P_i observed on a monthly basis:

$$y_i = \ln \frac{P_i}{P_{i-1}}$$

An annual return is generated by selecting randomly a set of 12 log-returns within the series of y_i and adding them together. This operation is repeated 10'000 times, and the 50th lowest result $Y_{0.5\%}$ is retained. The 99.5% VaR of the price process is then determined as $exp(Y_{0.5\%}) - 1$.

3.3.3.1.2 Data used

113. The stress factor for listed equity in developed markets has been determined based on the *FTSE Developed* index (Bloomberg ticker FTS5DEV) from January 1994 to December 2015.

114. The stress factor for listed equity in emerging markets has been determined based on the *FTSE Emerging* index (Bloomberg ticker FTS5ALEM) from January 1994 to December 2015.

3.3.3.2 Level stress – infrastructure equity (segments ii. and iv.)

3.3.3.2.1 Methodology

115. The calibration for infrastructure equity was determined by reference to the calibration to listed equity, using a three-step approach:

a. Step 1: calculate relevant 99.5% VaR using the three methods described below, over a common time period, for infrastructure equity on the one hand, general equity on the other hand.
b. Step 2: determine a relativity factor for infrastructure, equal to the ratio between the 99.5% VaR for infrastructure and general equity as calculated in Step 1.
c. Step 3: apply the relativity factor determined in Step 2 to the stress factors applicable to listed equity, as calculated in section 3.3.3.1.

116. The three methods used under Step 1 are Methods 2, 3 and 4 described in section 3.3.3.1.1, adjusted to remove the effect of the drift. Those methods are specified below as Method 2 bis, 3 bis and 4 bis:

Method 2 bis: geometric Brownian motion (without drift)

The inputs to Method 2 bis are the log-returns y_i of an index price P_i observed on a monthly basis:

$$y_i = \ln \frac{P_i}{P_{i-1}}$$

The yearly volatility of the geometric Brownian motion that prices are assumed to follow is estimated as:

$$s = \sqrt{12 . v}$$

where v denotes the empirical variance of the series of y_i.

The 99.5% VaR of the price process is then calculated as $exp(Y_{0.5\%}) - 1$, where $Y_{0.5\%}$ is the 0.5% percentile of a normal distribution of mean $-\frac{s^2}{2}$ and standard deviation s.

Method 3 bis: log-normal distribution of annual returns (without drift)

The inputs to Method 3 bis are the log-returns y_i of an index price P_i observed on an annual basis:

$$y_i = \ln \frac{P_i}{P_{i-1}}$$

The 99.5% VaR of log-returns $Y_{0.5\%}$ is calculated as the 0.5% percentile of a normal distribution of mean 0 and standard deviation s, where s denotes the empirical standard deviation of the series of y_i. The 99.5% VaR of the price process is then determined as $exp(Y_{0.5\%}) - 1$.

Method 4 bis: simulation based on observed monthly returns (without drift)

The inputs to Method 4 bis are the log-returns y_i of an index price P_i observed on a monthly basis:

$$y_i = \ln \frac{P_i}{P_{i-1}}$$

The annual trend of log-returns m is calculated as 12 times the empirical average of y_i.

An annual return is generated by selecting randomly a set of 12 log-returns within the series of y_i and adding them together. This operation is repeated 10’000 times, and the 50th lowest result $Y_{0.5\%}$ is retained. The 99.5% VaR of the price process is then determined as $exp(Y_{0.5\%} - m) - 1$.

The output of Step 2 is a relativity factor of 77% (i.e. the stress factor for infrastructure equity is 23% lower than for listed equity).

3.3.3.2.2 Data used

117. The data used to perform the calculations described above are monthly series of:

a. The EDHEC*Infra* Infra300® index

b. The FTSE All World index (Bloomberg ticker FTAW01)

between August 2011 and August 2022.

3.3.3.3 Level stress – hybrid debt / preference shares (segment v.)

118. Since the inception of the ICS, a specific category has been created for hybrid debt and preference shares. Stress factors for these assets are determined with reference to credit risk stress factors for corporate and reinsurance bonds with a 10-11-year maturity, with a correction to account for a higher Loss Given Default assumed for hybrid debt (75% for investment grade hybrid debt – ICS RC 1 to 3 – and 90% for non-investment grade) than for senior debt (45%).

119. In addition, out of prudence, ICS RC 6 and 7 have been merged for hybrid debt and preference shares, attracting an equity-like stress factor (35%).

3.3.3.4 Level stress – other equity (segments vi.)

3.3.3.4.1 Methodology

120. Stress factors are determined for three different asset classes, using the same methodology as used for listed equity, described in section 3.3.3.1.1.

121. The three asset classes chosen are:

a. Private equity;

b. Gold; and

c. Oil.

122. The three stress factors are then combined into one using the following weights, which were chosen based on expert judgement:

a. 50% for the private equity factor;

b. 25% for the gold factor; and

c. 25% for the oil factor.

3.3.3.4.2 Data used

123. The three indices used to derive the calibration for other equity:

a. A private equity index (Bloomberg ticker LPXIDITR) between January 1999 and December 2014;

b. A gold index (Bloomberg ticker BCOMGCTR) between January 1991 and December 2014; and

c. An oil index (Bloomberg ticker BCOMCLTR) between January 1991 and December 2014.

3.3.3.5 Volatility stress

124. Based on time series modelling of the VIX index (index of 1-month implied volatilities) with different combinations of ARMA and GARCH models, the 99.5% VaR of the relative increase in 1-month implied volatility has been determined to be 210%.

125. Separately, based on a random walk model, the shape of volatility 99.5% VaR stress factors depending on the tenor has been determined to be as follows:

Option term (months)	1	3	6	12	24	36	48	60	84	120	144	180
factor(t) / factor(1)	1	0.653	0.533	0.437	0.382	0.350	0.332	0.314	0.288	0.261	0.233	0.221

126. Under the assumption of an initial flat term structure of volatility at 20%, the levels of absolute volatility upward stresses are as follows:

Option term (months)	1	3	6	12	24	36	48	60	84	120	144	180
Factor	42%	28%	22%	18%	16%	15%	14%	13%	12%	11%	10%	9%

3.3.3.6 Neutral Adjusted Dampener (NAD)

127. The objective of the Neutral Adjusted Dampener (NAD) is to dampen the volatility of the solvency position of IAIGs resulting from market changes, reducing the risk of procyclical investment behaviour of the IAIGs, such as fire sales. Moreover, during periods of market exuberance, the increase of the equity risk charges is expected to increase the resilience with regard to future downturns.

128. The Neutral Adjusted Dampener is added to the raw level Equity risk charges for the following three level scenarios specified by segments of assets:

a. A decrease of the market prices of all listed shares in developed markets

b. A decrease of the market prices of all listed shares in emerging markets

c. A decrease of the market prices of all assets classified as other equity

129. The NAD is calculated using the following formula, for each of the above three level scenarios:

$$NAD = \left[a \times \left(\frac{CI_i - AI_i}{AI_i} - b\right)\right]_{-c}^{+c}$$

Where:

a. CI_i = Current Index value for category *i*

b. AI_i = x years moving average index for category *i*

c. *c* = This parameter provides a corridor to limit the impact of the NAD in extreme market conditions.

d. *a* = This parameter has the impact of dampening the NAD and therefore prevents a binary behaviour (either +c% or -c%)

e. *b* = This parameter aims to address the drawback whereby the NAD would always be positive and increasing in a positive accelerating market, even if the market change is a moderate/normal increase.

130. a, b, c and x are similar for the above three level scenarios and have been set based on expert judgement, in order to respond to the following targets:

a. The NAD should represent a positive and negative adjustment around the same number of times over a sufficiently long period of time, set between May 2000 and September 2022.

b. The average NAD value should be as close to zero as possible over a sufficiently long period of time, similarly set between May 2000 and September 2022.

131. The indices used for the purpose of the NAD calibration were the same as the ones used for determining the shocks of the raw level Equity risk charges.

132. As only one set of NAD parameters is defined for the above three level scenarios, the end-2022 average equity allocation of IAIGs participating to the Monitoring Period data collection has been used for the purpose of the calibration, ignoring hybrid debt and preference shares:

Weighted average	
Listed Developed	53%
Listed Emerging	7%
Hybrid debt and Pref shares	7%
Other equity	33%
Derivatives	0%

133. The NAD parameters obtained are the following:

NAD parameters	
a	50%
b	7%
c	10%
x (years)	3.0

3.3.3.7 Correlations

3.3.3.7.1 Correlation between listed equity in developed and emerging markets

134. The empirical linear correlation between annual log-returns of the FTSE Developed index and FTSE Emerging index is 69%, based on time series between 1995 and 2015. This value has been rounded up to 75% in the Equity correlation matrix.

3.3.3.7.2 Correlations between listed equity and other equity

135. The “other equity index” is defined as the weighted average of the following indices, normalised at the first common observed date:

a. A private equity index (with 50% weight);

b. A gold index (with 25% weight); and

c. An oil index (with 25% weight),

where the private equity, gold and oil indices are those specified in section 3.3.3.4.2, observed annually from January 1999 to January 2014.

136. The empirical linear correlation between the log-returns of the “other equity index” and the log-returns of the FTSE Developed index, observed on the 1999 – 2014 period, is 72%. This value has been rounded up to 75% in the Equity correlation matrix.

137. The empirical linear correlation between the log-returns of the “other equity index” and the log-returns of the FTSE Emerging index, observed on the 1999 – 2014 period, is 81%. This value has been rounded down to 75% in the Equity correlation matrix.

3.3.3.7.3 Correlations between listed equity and infrastructure equity

138. The empirical linear correlation between monthly log-returns of the Infra300® index and the FTSE Developed index is 91%, based on observations between August 2011 and August 2022. That correlation has been rounded up to 100% for aggregating the listed equity and infrastructure results within the Equity developed markets scenario.

139. The empirical linear correlation between monthly log-returns of the Infra300® index and the FTSE Emerging index is 45%, based on observations between August 2011 and August 2022. That correlation has been rounded up to 50% for aggregating the listed equity and infrastructure results within the Equity developed markets scenario.

3.3.3.7.4 Correlations between listed equity and hybrid debt / preference shares

140. Correlations are based on expert judgement.

3.4 Real estate risk

3.4.1 Definition

141. Real Estate risk is defined as the risk of adverse changes in the value of capital resources due to unexpected changes in the level or volatility of market prices of real estate or from the amount and timing of cash flows from investments in real estate.

3.4.2 ICS methodology

142. The ICS Real Estate risk charge is determined by applying a shock of a 25% simultaneous decrease in the value of all direct or indirect property exposures. Mortgages are excluded from Real Estate risk and included as part of Credit risk. When aggregated with other Market risks, the Non-Life risk charge for mortgage insurance is added to Real Estate risk.

3.4.3 Calibration

143. The calibration of the shock scenario for Real Estate risk has remained simple and stable throughout the ICS development.

144. Based on expert judgement, the stress factor was set to 25% in 2017 – consistent with the Solvency II real estate stress, also calibrated at a 99.5% level over a 1-year time horizon. Note that the Solvency II calibration for real estate is based on analysis of monthly UK Investment Property Data Bank Index total return indices from 1987 to 2008. This calibration has been confirmed in the recent 2020 Solvency II review[14].

145. In their response to the 2018 ICS public consultation, stakeholders generally supported the proposed calibration, resulting in no change.

[14] See background document on the opinion on the 2020 review of Solvency II

3.5 Currency risk

3.5.1 Definition

146. Currency risk is the risk of adverse change in the value of capital resources due to unexpected changes in the level or volatility of currency exchange rates. This risk may arise from the assets and/or liabilities, taking into account that changes in the value of some items on the balance sheet may be partially or totally offset by changes in value of other items on the balance sheet.

3.5.2 ICS methodology

147. The ICS Currency risk charge is the higher of the aggregated losses incurred under two scenarios stressing the exchange rates between the IAIG's consolidated group level reporting currency and those currencies in which the IAIG holds assets or liabilities. The two stress scenarios are:

a. Scenario 1: All currencies in which the IAIG has a net long position decrease in value against the reporting currency, while all currencies in which the IAIG has a net short position remain unchanged; and

b. Scenario 2: All currencies in which the IAIG has a net short position increase in value against the reporting currency, while all currencies in which the IAIG has a net long position remain unchanged.

148. The stress applies on the net open position (Assets – Liabilities) for each currency after allowing an exemption for investments in foreign subsidiaries up to 10% of the net insurance liabilities in a currency from the net open (long) position in that currency.

149. A diversification allowance (i.e. pairwise correlation of 50%) is assumed between the stressed results by currency.

150. The currency level stresses are determined using granular pairwise bidirectional relative currency stresses.

3.5.3 Calibration

151. The Currency risk section of the 2016 ICS public consultation included the proposed methodology, along with stresses, single correlation factors for all currencies in a time of stress, treatment of investments in foreign subsidiaries, treatment of currency pegs and treatment of currency exposures with a maturity of less than one year.

152. The 10% exemption for investments in foreign subsidiaries has been selected as a proxy of the average capital requirement across jurisdictions.

153. Pair-wise volatilities have been calculated using weekly exchange rate data from 1 January 1999 to 31 December 2018 for each pair of currencies for 35 predefined currencies.

154. Weekly volatilities have then been converted to a 99.5% VaR over a 1-year time horizon, using a square root of time derived gross up factor and assuming a normal distribution. The results have been rounded to the nearest 5% value, with an absolute 2% floor.

3.6 Asset concentration risk

3.6.1 Definition

155. The Asset Concentration risk charge is an incremental risk charge above the Market and Credit risk charges, which acknowledges that assets held by IAIGs are not perfectly diversified.

3.6.2 ICS methodology

156. The Asset concentration risk charge calculation involves a risk charge for:

a. real estate; and

b. assets other than real estate.

157. The sum of a) and b) above is the risk charge for asset concentration.

3.6.3 Calibration

3.6.3.1 Real estate

158. Due to insufficient data expert judgement was applied. The radius of 250 metres to identify group of properties to identify single exposure are based on the values identified for the terrorist attack submodule. The level of 3% is based on expert judgement and the stress level is consistent with the level of stress for real estate.

3.6.3.2 Assets other than real estate

3.6.3.2.1 Methodology

159. The methodology is based on the paper *Granularity Adjustment for Regulatory Capital Assessment* by Gordy and Luetkebohmert.[15]

160. The paper provides an approximation for the theoretical framework of a granularity adjustment, which is further reduced to a simplified granularity adjustment $\widetilde{GA}$

$$\widetilde{GA} = \frac{1}{2K^*} \sum_{i=1}^{n} s_i^2 \, C_i[\delta(K_i + R_i) - K_i].$$

161. Further details can be found in the paper. Roughly speaking s_i can be interpreted as the portfolio share, K_i as the unexpected loss, R_i as the expected loss. C_i is a term depending on the variance and expected value of loss given default (LGD) of asset i and δ is parameter that depends on the quantile of the distribution and a so-called precision parameter ξ (which is proposed to be set to 0.25 in the paper).

3.6.3.2.2 Assumptions

162. The following assumptions (going beyond the assumptions made in the paper) were made to determine the risk charge for the ICS.

a. Assume $LGD_i = LGD = 0.45$ to determine C_i. This choice is consistent with the assumptions for Credit risk.

b. R_i is relatively small compared to K_i

c. $K_i + R_i$ is the ICS Equity and Credit risk charge.

[15] Granularity Adjustment for Regulatory Capital Assessment (ijcb.org)

163. Using these assumptions (and as proposed in the paper that X (the risk factor) is gamma distributed with mean $\mu = 1$ and variance $\sigma^2 = \frac{1}{\xi}$) yields

$$\widehat{GA} = 0.71656 \frac{\sum_{i=1}^{n} E_i K_i}{\sum_{i=1}^{n} K_i},$$

164. Where E_i is the net exposure to group of connected counterparties i and K_i is the total risk charge for Credit and Equity risk before diversification and management actions.

165. To limit the burden for IAIG to determine all connected counterparties a threshold value T was introduced. This threshold value T is to be chosen in a way such that the number of connected counterparties for which $E_i > T$ holds, is greater than 10 but does not exceed 100.

$$f \times \left(\frac{\sum_{E_i > T} (E_i - T)(d.K_i^{eq} + K_i^{cr})}{(d.K^{eq} + K^{cr})} + T \right)$$

where:

a. $f = 0.71656$;

b. $d = 0.95$;

c. E_i is the net exposure to group of connected counterparties i;

d. T is an exposure threshold determined by the IAIG in such a way that the number of groups of connected counterparties i for which $E_i > T$ is equal to or greater than 10 but does not exceed 100;

e. K_i^{eq} is the Equity risk charge associated with counterparty i, before diversification and management actions;

f. K_i^{cr} is the Credit risk charge associated with counterparty i, before diversification and management actions;

g. K^{eq} is the total Equity risk charge of the IAIG, before diversification and management actions; and

h. K^{cr} is the total Credit risk charge of the IAIG, before diversification and management actions.

166. The value d is based on expert judgement.

4 Credit Risk

4.1 Definition

167. Credit Risk aims to capture the risk of adverse changes in the value of capital resources due to unexpected changes in the actual default as well as in the deterioration of an obligor's credit worthiness short of default, including migration risk, and spread risk due to defaults.

4.2 ICS methodology

168. Credit risk is calculated by applying prescribed stress factors to specified net exposure amounts. The credit risk charge is the sum of each stress factor applied based on the specified net exposures amounts. Management actions are taken into consideration in the calculation of the credit risk charge.

169. The credit risk charge applies to all senior debt obligations of specified exposure classes of borrowers.

170. Regional governments and municipal authorities and other government entities whose debt is not issued or guaranteed by the national government, are classified as public sector entities. Exposures to commercial undertakings owned but not guaranteed by governments or municipal authorities are classified as corporates.

171. The infrastructure category includes debt exposures to infrastructure projects and corporates that meet specific definitions and criteria.

172. The securitisation category includes all holdings of mortgage-backed securities and other asset-backed securities. If any of the assets in the pool of exposures underlying a securitisation exposure are themselves a securitisation, then the exposure belongs to the re-securitisation category.

4.3 Calibration

4.3.1 Calibration of credit risk stress factors

173. The Credit risk charge is determined by applying prescribed stress factors to specified net exposure amounts. The credit risk stress factors have been calibrated for the following exposure classes by ICS Rating Category (RC) and maturity.

a. Public sector entities
b. Corporates and reinsurance
c. Infrastructure
d. Securitisations
e. Re-securitisations
f. Mortgage loans
    i. Agricultural and commercial mortgages
    ii. Residential mortgages

174. For public sector entities, corporates and reinsurance, infrastructure, securitisations and re-securitisations exposures, single factors for all maturities beyond 14 years have been derived because of data availability.

4.3.2 Calibration for corporate credit exposures

175. The basis for the credit risk calibration for corporate credit exposures is an asymptotic single risk factor credit risk model and incorporates the risk of a decrease in value of an asset due to deterioration of the obligor's creditworthiness impacting the probability of default over time.

176. The stress factors reflect both the expected loss over a risk horizon of one year and the downgrade risk over the remaining maturity of the exposure.

177. The stress factor, K, is calculated as:

K = Expected Loss + Downgrade Risk

4.3.2.1 Expected Loss

178. The expected loss is based on the stressed probability of default (SPD) and the loss-given-default (LGD) with:

Expected Loss = LGD x SPD

179. The credit risk model defines the following a formula for the stress probability of default over a given time horizon at any given confidence level, (where PD is the probability of default)

$$SPD = N\left(\frac{N^{-1}(PD_H) - \sqrt{\rho}\,N^{-1}(\alpha)}{\sqrt{1-\rho}}\right)$$

180. LGD is assumed to be a constant of 45%, consistent with the approach used in Basel II.

4.3.2.2 Downgrade Risk

181. The potential decrease in value of an asset due to deterioration of the obligor's creditworthiness has been calculated based on the valuation techniques described in the paper "The Distribution of Loan Portfolio Value" by Oldrich Vasicek.

182. The factor for downgrade is given by:

$$e^{-rH}\,\frac{V_{\text{expected}} - V_{\text{stress}}}{V_{\text{current}}}$$

Where:

a. V_{expected} is the expected value of the bond at time H.

b. V_{stress} is the expected value under stress of the bond at time H; and

c. V_{current} is the current value of the bond.

183. The expected value and stress value of the bond price at time H are calculated by applying the Vasicek model and using a risk-neutral PD to value the bond to account for the risk premium associated with credit risk that is reflected in the bond price. The formula for the bond price at time H is given by:

$$e^{-r(T-H)}(1 - LGD \times PD^{*})$$

where r is the bond yield, and PD^{*} is the risk-neutral probability of default from time H to time T. The risk-neutral probability of default is derived from the real-world probability of default via the relation:

$$PD^* = N\left(N^{-1}(PD) + \lambda\rho\sqrt{T-H}\right)$$

with λ denoting the market price of risk.

184. The stress probability of default between times H and T is given by:

$$P(\log A_T < \log B_T)$$
$$= N\left(\frac{\sqrt{T}\,N^{-1}(PD_T) - \sqrt{H}\sqrt{\rho}\,N^{-1}(\alpha) - \sqrt{H}\sqrt{1-\rho}\,Z_H}{\sqrt{T-H}}\right)$$

and the stress risk-neutral probability of default is given by:

$$N\left(\frac{\sqrt{T}\,N^{-1}(PD_T) - \sqrt{H}\sqrt{\rho}\,N^{-1}(\alpha) - \sqrt{H}\sqrt{1-\rho}\,Z_H}{\sqrt{T-H}} + \lambda\rho\sqrt{T-H}\right)$$

where the random variable Z_H, has a truncated normal distribution.

185. Integrating the bond price over all possible values of Z_H gives an expected bond price under stress V_{stress} of:

$$V_{\text{stress}} = e^{-r(T-H)}\left[1 - \frac{LGD}{1-SPD}\int_{N^{-1}(SPD)}^{\infty} N(aZ+b)\,dN(Z)\right]$$

An expected value of the bond at time H V_{expected} of:

$$V_{\text{expected}} = e^{-r(T-H)}\left(1 - LGD \times N\left(N^{-1}(PD) + \lambda\rho\sqrt{T-H}\right)\right)$$

And current value of the bond, V_{current} of:

$$V_{\text{current}} = e^{-rT}\left(1 - LGD \times N\left(N^{-1}(PD) + \lambda\rho\sqrt{T}\right)\right)$$

4.3.2.3 Data and assumptions

186. The cumulative probabilities of default PD_H and PD_T, for corporate credit exposures have been derived from the 2013 Standard & Poor's annual global corporate default study and rating transitions. The confidence level for ICS is 99.5% and so α=0.005.

187. All of the remaining model parameters are the same as under the Basel IRB approach:

a. The bond interest rate r is set at 5% annually.

b. The correlation parament, ρ varies by credit rating, and is given by:

$$\rho = 0.24 - 0.12\,\frac{1 - e^{-50\,PD_H}}{1 - e^{-50}}$$

c. The market price of risk[16], λ is given by:

$$\lambda = \frac{0.40625 \times (T-H)^{0.0093}}{\sqrt{\rho}}$$

d. As noted above, LGD is set as a constant of 45%.

[16] This assumption is taken from confidential analysis used in the derivation of the Basel IRB approach.

4.3.3 Public sector entities

188. The calibration of public sector entities is based on the risk factors for corporate exposures but with the credit risk factors adjusted to reflect their lower risk profile.

189. These adjustments to the corporate credit risk factors were based on expert judgement.

190. For ICS credit rating 1 and 2 the credit risk factors are half of the equivalent factors for corporate exposure.

191. For ICS credit rating 3 – 7, the credit risk stress factors applied are those for an exposure half a risk category stronger than for corporate exposures. Therefore, the stress factor at each duration for ICS RC 3 is calculated as the average of the corporate credit stress factors for ICS RC 2 and 3.

192. Unrated exposures assume the same risk factor as those for ICS RC 5.

4.3.4 Reinsurance

193. The credit risk calibration for reinsurance exposures is assumed to be the same as for corporate exposures, based on expert judgement.

4.3.5 Infrastructure

194. For infrastructure exposures the risk factors used are the same as for corporate exposures except for unrated exposures where the risk factor is set at 75% of the equivalent risk factor by duration for corporate exposures. This calibration is based on the performance of infrastructure assets compared to corporate exposures.

195. This assessment was based on analysis of the historical cumulative default rate (CDR) from rating agencies, from Moody's 2020 default and recovery rates study (1983-2020 data) and Standard & Poor's 2020 annual infrastructure default and rating transition study (1981-2020 data).

4.3.6 Securitisations

196. For Securitised exposures the credit risk factors are the same as for corporate exposures with RC 1-4.

197. For RC 5, the risk factor is 300% of the equivalent corporate exposure risk factor.

198. Anything rated below RC 5 is assumed to have a risk factor of 100% (i.e. the loss of entire value)

199. These adjustments to the corporate credit risk factors were based on analysis supporting the Basel IRB framework.

4.3.7 Re-securitisations

200. For Re-securitised exposures the credit risk factors are 200% of those for corporate exposures with RC 1-4.

201. For RC 5, the risk factor is 600% of the equivalent corporate exposure risk factor.

202. Anything rated below RC 5 is assumed to have a risk factor of 1 (i.e. loss of entire value)

203. These adjustments to the corporate credit risk factors were based on analysis supporting the Basel IRB framework.

4.3.8 Mortgage loans

204. The credit risk factors are based on the credit risk weights for mortgages from Annex 1 of the Basel Framework.

205. For agricultural, commercial and residential mortgages a scalar of 75% was used to recalibrate the mortgage risk weights from Annex 1 of the Basel Framework from a 99.9% Value at Risk to a 99.5% Value at Risk.

4.3.9 Other factors

206. Other factors used for the purpose of Credit risk calculation are based on expert judgement or on a direct reference to the Basel Framework in the specific case of OTC derivatives.

5 Operational risk

5.1 Definition

207. Operational risk is the risk of adverse change in the value of capital resources due to operational events including inadequate or failed internal processes, people and systems, or from external events. Operational risk includes legal and conduct risk but excludes strategic and reputational risk.

5.2 ICS methodology

208. The Operational risk charge has components for gross current estimates, gross written premiums, and growth. Life insurance also has a separate factor for non-risk business where policyholders bear the investment risk. The risk charge is calculated as follows:

$$
\begin{aligned}
Op\ risk\ charge\ =\ & \max\ [\text{non\_life\_premium\_exposure} * \text{factor}, \text{non\_life\_liability\_exposure} \\
& * \text{factor}]\ + \text{non\_life\_growth\_exposure}\ * \text{factor} \\
& + \max\ [\text{life\_(risk)\_premium\_exposure}\ * \text{factor}, \text{life\_(risk)\_liability\_exposure} \\
& * \text{factor}]\ + \text{life\_(risk)\_growth\_exposure}\ * \text{factor} \\
& + \text{life\_(non\_risk)\_liability\_exposure}\ * \text{factor}
\end{aligned}
$$

With the following factors:

	Premium	Growth	Liabilities
Risk from Non-Life Operations			
Exposure	Gross written premium (GWP) in most recent financial year	GWP in most recent financial year in excess of the growth threshold (20%) compared to the previous year's GWP	Gross current estimate
Factor	2.75%	2.75%	2.75%
Risk from Life Operations			
Exposure	**Life (risk):** GWP in most recent financial year	**Life (risk):** GWP in most recent financial year in excess of the growth threshold (20%) compared to the previous year's GWP	**Life (risk):** Gross current estimate **Life (non-risk):** Gross current estimate
Factor	**Life (risk):** 4%	**Life (risk):** 4%	**Life (risk):** 0.45% **Life (non-risk):** 0.40%

5.3 Calibration

209. The initial calibration for Operational risk was based essentially on a review of existing frameworks (in particular Solvency II), with adjustments based on expert judgement.

210. In 2009, the Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS) published advice on the calibration of Operational risk in Solvency II, that has been used by the IAIS to benchmark its own calibration for the ICS. As part of this paper[17], CEIOPS carried out their analysis and provided a summary of external information on the calibration of Operational risk. A table comparing CEIOPS selection of factors to the 2018 ICS factors can be found below. Differences are due to expert judgement.

Exposure	CEIOPS Selection	ICS Factor (2018 methodology)	Notes
Gross Current Estimate -- Life (risk)	0.6% *	0.4%	*Includes zero floor on technical provisions; in underlying analysis, the NL CE excluded premium liabilities.
Gross Current Estimate – Non-Life	3.6% *	2.75%	
Gross Premium – Life (risk)	5.5%**	4.0%	**Exposure is earned (not written) premium.
Gross Premium – Non-Life	3.8%**	2.75%	

211. The calibration was then monitored over time, using the ratio between the Operational risk charge and the ICS capital requirement. According to that benchmark indicator, the ICS Operational risk charge appeared to be in line with results provided in a 2016 survey from ORIC International on capital benchmarking[18], which reported an average ratio between “diversified operational risk capital requirement” and “diversified group capital requirement” of 7.3%.

212. Nevertheless, the Life (Non-risk) factor was deemed to be excessively high compared to the Life (risk) one. Therefore, the calibration for Life (risk) has been increased from 0.4% to 0.45% of liabilities and decreased from 0.45% to 0.4% of liabilities for Life (Non-risk).

[17] CEIOPS-DOC-45-09-L2-Advice-Standard-Formula-operational-risk (europa.eu)

[18] Capital Benchmarking | Oric international

6 Aggregation/Diversification of ICS risk charges

6.1 Definition

213. The aggregation of risks refers to the process within the ICS where the various risk components are combined. By embedding the interdependencies between different risks modules, aggregation ensures that the benefits of risk diversification are appropriately incorporated when determining the ICS capital requirement.

6.2 ICS methodology

214. In order to reflect the diversification in the calculation of the ICS capital requirement, the ICS is using a variance-covariance matrix approach to aggregate individual risk charges. It is applied in multiple steps:

a. A top-level aggregation between major risk categories (Life risk, Non-life risk, Catastrophe risk, Market risk, Credit risk and Operational risk);

b. A medium-level aggregation between the sub-risks of Life risk, Catastrophe risk and Market risk; and

c. An aggregation within individual risk charges (eg Interest rate risk, Non-life risk).

6.3 Calibration

215. The structure of correlation matrices set out in the ICS represents a trade-off between simplicity and risk sensitivity. The multiple-step approach offers the benefit of limiting the number of correlation parameters to be specified, but reduces the risk sensitivity that a single matrix (including the correlation between each individual risk) would have produced.

216. In the context of the ICS standard method, the correlation parameters have been calibrated in order for the ICS to meet its target criteria of a 99.5% VaR confidence level. Correlation parameters that are valid for the tail of distributions might differ from parameters valid for the average or lower part of the distributions. As an example, in a stressed environment some correlations may increase. Therefore, the availability of data on which to base a calibration of the correlation parameters has been limited. As such, correlation matrices were derived based on an expert judgement assessment of a qualitative level of correlation between risks (negative, null, low, medium or high). That qualitative assessment was then translated into correlation factors, using the following correspondence:

a. Negative: -0.25;

b. Null: 0;

c. Low: 0.25;

d. Medium: 0.5; and

e. High: 0.75.

217. The choice has been made for operational risk to be simply added to other risk charges after their aggregation, assuming therefore an absence of correlation between operational risk and all other risks. Indeed, operational risk events can be idiosyncratic and unrelated to other ICS risks, leading to significant financial losses that cannot be appropriately and effectively reduced by diversification.

7 Annex

7.1 Insurance risks

7.1.1 Life insurance risks

Life risks correlation matrix

	Mortality	Longevity	Morbidity/ Disability	Lapse	Expense
Mortality	100%	-25%	25%	0%	25%
Longevity	-25%	100%	0%	25%	25%
Morbidity/ Disability	25%	0%	100%	0%	50%
Lapse	0%	25%	0%	100%	50%
Expense	25%	25%	50%	50%	100%

Mortality risk stress factors

Region	x%
EEA and Switzerland	12.5 %
US and Canada	12.5 %
China	15.0 %
Japan	10.0 %
Other developed markets	12.5 %
Other emerging markets	12.5 %

Longevity risk stress factors

Region	x%
EEA and Switzerland	17.5 %
US and Canada	17.5 %
China	17.5 %
Japan	17.5 %
Other developed markets	17.5 %
Other emerging markets	17.5 %

Morbidity/Disability risk stress factors – Location of risk Japan

Category (i)	Short-term	Long-term
1	20%	8%
2	25%	15%
3	20%	10%
4	inception rate stress = 25%, recovery rate stress=20%	inception rate stress = 20%, recovery rate stress = 20%

Morbidity/Disability risk stress factors – All other locations of risk

Category (i)	Short-term	Long-term
1	20%	8%
2	25%	20%
3	20%	12%
4	inception rate stress = 25%, recovery rate stress=20%	inception rate stress = 20%, recovery rate stress = 20%

Level & Trend Lapse risk stress factors

Region	x%
EEA and Switzerland	40%
US and Canada	40%
China	40%
Japan	20%
Other developed markets	40%
Other emerging markets	40%

Expense risk stress factors

Region	x% (unit expense)	y% (expense inflation)
EEA and Switzerland	6%	1%
US and Canada	6%	1%
China	8%	Year 1 – 10: 3%; Year 11 – 20: 2%; Year 21 onwards: 1%
Japan	6%	1%
Other developed markets	8%	Year 1 – 10: 2%; Year 11 onwards: 1%
Other emerging markets	8%	Year 1 – 10: 3%; Year 11 – 20: 2%; Year 21 onwards: 1%

7.1.2 Non-Life risk

Within Category Correlation Factors

ICS Categories	Correlation factor between segments within the category
Liability-like	50%
Motor-like	75%
Property-like	50%
Other	25%

ICS Non-Life Segmentation

ICS Segment		ICS Category	Premium risk factor	Claims Reserve risk factor
EEA and Switzerland	Medical expense insurance	Other	15%	10%
	Income protection	Other	25%	35%
	Workers' Compensation	Liability-like	25%	27%

ICS Segment		ICS Category	Premium risk factor	Claims Reserve risk factor
	Motor vehicle liability - Motor third party liability	Motor-like	20%	15%
	Motor, other classes	Motor-like	20%	15%
	Marine, aviation and transport	Property-like	35%	25%
	Fire and other damage	Property-like	17.5%	17.5%
	General liability - third party liability	Liability-like	35%	27%
	Credit and suretyship	Credit	35%	50%
	Legal expenses	Other	15%	40%
	Assistance	Other	15%	50%
	Miscellaneous financial loss	Other	30%	35%
	Non-proportional health reinsurance	Other	50%	45%
	Non-proportional Casualty reinsurance	Liability-like	55%	45%
	Non-proportional marine, aviation and transport reinsurance	Property-like	55%	40%
	Non-Proportional property reinsurance	Property-like	45%	40%
Canada	Property - personal	Property-like	35%	25%
	Home Warranty	Property-like	30%	25%
	Product Warranty	Property-like	30%	25%
	Property - commercial	Property-like	30%	30%
	Aircraft	Property-like	45%	35%
	Automobile - liability/personal accident	Motor-like	35%	20%
	Automobile - other	Motor-like	35%	20%
	Boiler and Machinery	Property-like	30%	25%
	Equipment Warranty	Property-like	30%	25%
	Credit Insurance	Credit	45%	30%

ICS Segment		ICS Category	Premium risk factor	Claims Reserve risk factor
	Credit Protection	Credit	45%	30%
	Fidelity	Other	45%	30%
	Hail	Property-like	35%	30%
	Legal Expenses	Other	45%	40%
	Liability	Liability-like	50%	38%
	Mortgage	Mortgage	45%	30%
	Surety	Credit	45%	30%
	Title	Liability-like	35%	30%
	Marine	Property-like	45%	35%
	Accident and Sickness	Other	45%	30%
	Other Approved Products	Other	45%	35%
US	Auto physical damage	Motor-like	12.5%	10%
	Homeowners/ Farm owners	Property-like	30%	15%
	Special property	Property-like	25%	17.5%
	Private passenger auto liability/ medical	Motor-like	15%	15%
	Commercial auto/ truck liability/ medical	Motor-like	15%	15%
	Workers' compensation	Liability-like	15%	16%
	Commercial multi-peril	Liability-like	30%	26%
	Medical professional liability -- Occurrence	Liability-like	40%	45%
	Medical professional liability – Claims-Made	Liability-like	30%	35%
	Other Liability – Occurrence	Liability-like	17.5%	28%
	Other Liability – Claims-Made	Liability-like	15%	20%
	Products liability	Liability-like	45%	47%

ICS Segment		ICS Category	Premium risk factor	Claims Reserve risk factor
	Reinsurance – non-proportional assumed property	Property-like	35%	25%
	Reinsurance – non-proportional assumed liability	Liability-like	45%	39%
	Special liability	Liability-like	30%	25%
	Mortgage insurance	Mortgage	45%	30%
	Fidelity/surety	Credit	35%	40%
	Financial Guaranty	Credit	45%	25%
	Other	Other	25%	35%
	Reinsurance – non-proportional assumed financial lines	Other	45%	20%
China	Motor	Motor-like	10%	20%
	Property, including commercial, personal and engineering	Property-like	30%	45%
	Marine and Special	Property-like	25%	45%
	Liability	Liability-like	10%	36%
	Agriculture	Property-like	25%	35%
	Credit	Credit	45%	35%
	Short-term Accident	Other	10%	10%
	Short-term Health	Other	10%	10%
	Short-term Life	Other	10%	20%
	Others	Other	35%	20%
Japan	Fire	Property-like	20%	35%
	Hull	Property-like	40%	35%
	Cargo	Property-like	35%	40%
	Transit	Property-like	40%	35%
	Personal Accident	Other	10%	15%
	Automobile	Motor-like	7.5%	10%

ICS Segment		ICS Category	Premium risk factor	Claims Reserve risk factor
	Aviation	Property-like	50%	45%
	Guarantee Ins.	Credit	35%	40%
	Machinery	Property-like	35%	40%
	General Liability	Liability-like	17.5%	27%
	Contractor's All Risks	Property-like	35%	40%
	Movables All Risks	Property-like	17.5%	25%
	Workers' Compensation	Liability-like	35%	22%
	Misc. Pecuniary Loss	Other	35%	45%
	Nursing Care Ins.	Other	35%	45%
	Others	Other	35%	40%
Australia and New Zealand	Householders	Property-like	30%	20%
	Commercial Motor	Motor-like	25%	20%
	Domestic Motor	Motor-like	25%	20%
	Other type A	Other	25%	20%
	Travel	Other	35%	25%
	Fire and ISR	Property-like	30%	25%
	Marine and Aviation	Property-like	35%	25%
	Consumer Credit	Credit	35%	15%
	Other Accident	Other	35%	25%
	Other type B	Other	35%	35%
	Mortgage	Mortgage	45%	30%
	CTP	Motor-like	45%	35%
	Public and Product Liability	Liability-like	45%	31%
	Professional Indemnity	Liability-like	45%	35%
	Employers' Liability	Liability-like	45%	36%
	Short tail medical expenses	Other	15%	25%

ICS Segment		ICS Category	Premium risk factor	Claims Reserve risk factor
	Other type C	Other	45%	35%
	Householders - non-prop reins	Property-like	45%	30%
	Commercial Motor - non-prop reins	Motor-like	45%	30%
	Domestic Motor - non-prop reins	Motor-like	45%	30%
	Other non-prop reins type A	Other	45%	30%
	Travel - non-prop reins	Other	45%	35%
	Fire and ISR - non-prop reins	Property-like	55%	40%
	Marine and Aviation - non-prop reins	Property-like	55%	40%
	Consumer Credit - non-prop reins	Credit	55%	40%
	Other Accident - non-prop reins	Other	55%	40%
	Other non-prop reins type B	Other	55%	35%
	Mortgage - non-prop reins	Mortgage	50%	35%
	CTP - non-prop reins	Motor-like	55%	40%
	Public and Product Liability - non-prop reins	Liability-like	55%	43%
	Professional Indemnity - non-prop reins	Liability-like	55%	40%
	Employer's Liability - non-prop reins	Liability-like	55%	43%
	Other non-prop reins type C	Other	55%	40%
Hong Kong SAR	Accident and health	Other	10%	25%
	Motor vehicle, damage and liability	Motor-like	25%	15%
	Aircraft, damage and liability	Property-like	45%	40%
	Ships, damage and liability	Property-like	45%	40%
	Goods in transit	Property-like	45%	50%
	Fire and Property damage	Property-like	35%	20%
	General liability	Liability-like	45%	26%
	Pecuniary loss	Other	45%	35%

ICS Segment		ICS Category	Premium risk factor	Claims Reserve risk factor
	Non-proportional treaty reinsurance	Property-like	45%	25%
	Proportional treaty reinsurance	Property-like	35%	35%
Korea	Fire, technology, overseas	Property-like	25%	30%
	Package	Property-like	35%	50%
	Maritime	Property-like	45%	45%
	Personal injury	Other	35%	50%
	Workers accident, liability	Liability-like	12.5%	31%
	Foreigners	Other	15%	10%
	Advance payment refund guarantee	Credit	50%	50%
	Other Non-life	Other	45%	50%
	Private vehicle (personal injury)	Motor-like	15%	30%
	Private vehicle (property, vehicles damage)	Motor-like	25%	35%
	Vehicle for commercial or business purpose(personal injury)	Motor-like	25%	20%
	Vehicle for commercial or business purpose(property, vehicles)	Motor-like	25%	20%
	Other motor	Motor-like	15%	20%
Singapore	Personal Accident	Other	30%	25%
	Singapore/Health	Other	25%	20%
	Singapore/Fire	Property-like	30%	25%
	Marine and Aviation - Cargo	Property-like	35%	30%
	Motor	Motor-like	30%	25%
	Work Injury Compensation	Liability-like	35%	31%
	Bonds	Credit	35%	30%
	Engineering Construction	Property-like	35%	30%
	Credit	Credit	35%	30%

ICS Segment		ICS Category	Premium risk factor	Claims Reserve risk factor
	Mortgage	Mortgage	35%	30%
	Others- non liability class	Other	35%	30%
	Marine and Aviation - Hull	Property-like	45%	35%
	Professional indemnity	Liability-like	35%	35%
	Public liability	Liability-like	35%	31%
	Others - liability class	Liability-like	35%	31%
Chinese Taipei	Fire - residence	Property-like	25%	40%
	Fire - commercial	Property-like	55%	45%
	Marine - inland cargo	Property-like	30%	25%
	Marine - overseas cargo	Property-like	30%	25%
	Marine - hull	Property-like	55%	45%
	Marine - fish boat	Property-like	45%	45%
	Marine - aircraft	Property-like	55%	45%
	Motor - personal vehicle	Motor-like	25%	25%
	Motor - commercial vehicle	Motor-like	25%	25%
	Motor - personal liability	Motor-like	25%	25%
	Motor - commercial liability	Motor-like	25%	25%
	Liability - public, employer, product, etc.	Liability-like	35%	36%
	Liability - professional	Liability-like	35%	35%
	Engineering	Property-like	55%	45%
	Nuclear power station	Property-like	55%	45%
	Guarantee - surety, fidelity	Credit	55%	45%
	Credit	Credit	55%	45%
	Other property damage	Property-like	35%	40%
	Accident	Other	15%	10%

ICS Segment		ICS Category	Premium risk factor	Claims Reserve risk factor
	Property Damage - commercial earthquake	Property-like	45%	35%
	Comprehensive - personal property and liability	Property-like	45%	45%
	Comprehensive - commercial property and liability	Property-like	45%	45%
	Property damage - typhoon and flood	Property-like	55%	45%
	Property damage - compulsory earthquake	Property-like	55%	45%
	Health	Other	15%	10%
Other Developed	Motor	Motor-like	30%	20%
	Property damage	Property-like	30%	25%
	Accident, protection and health (APH)	Other	35%	30%
	Short tail medical expenses	Other	35%	25%
	Other short tail	Other	35%	30%
	Marine, Air, Transport (MAT)	Property-like	35%	35%
	Workers' compensation	Liability-like	35%	36%
	Public liability	Liability-like	35%	31%
	Product liability	Liability-like	35%	43%
	Professional indemnity	Liability-like	35%	35%
	Other liability and other long tail	Liability-like	35%	36%
	Non-proportional motor, property damage, APH and MAT	Property-like	50%	40%
	Catastrophe reinsurance	Property-like	50%	40%
	Non-proportional liability	Liability-like	50%	44%
	Non-proportional professional indemnity	Liability-like	50%	40%
	Mortgage insurance	Mortgage	45%	35%

ICS Segment		ICS Category	Premium risk factor	Claims Reserve risk factor
	Commercial credit insurance	Credit	45%	35%
	Other medium-term	Other	50%	40%
Other Emerging	Motor	Motor-like	35%	25%
	Property damage	Property-like	35%	30%
	Accident, protection and health (APH)	Other	35%	30%
	Short tail medical expenses	Other	35%	25%
	Other short tail	Other	35%	30%
	Marine, Air, Transport (MAT)	Property-like	35%	35%
	Workers' compensation	Liability-like	45%	36%
	Public liability	Liability-like	45%	36%
	Product liability	Liability-like	45%	47%
	Professional indemnity	Liability-like	45%	35%
	Other liability and other long tail	Liability-like	45%	36%
	Non-proportional motor, property damage, APH and MAT	Property-like	50%	45%
	Catastrophe reinsurance	Property-like	50%	45%
	Non proportional liability	Liability-like	50%	48%
	Non-proportional professional indemnity	Liability-like	50%	45%
	Mortgage insurance	Mortgage	50%	40%
	Commercial credit insurance	Credit	50%	40%
	Other medium-term	Other	55%	40%

7.1.3 Catastrophe risk

Catastrophe Risk - Credit stress factors for trade credit

Rating category	Factor
Investment Grade	80%

Rating category	Factor
Non-Investment Grade	200%

7.2 Market risks

Market risks correlation matrix

	Interest rate	NDSR Up	NDSR Down	Equity	Real Estate	Currency	Asset concentration
Interest rate	100%	25%	25%	25%	25%	25%	0%
NDSR Up	25%	100%	100%	75%	50%	25%	0%
NDSR Down	25%	100%	100%	0%	0%	25%	0%
Equity	25%	75%	0%	100%	50%	25%	0%
Real estate	25%	50%	0%	50%	100%	25%	0%
Currency	25%	25%	25%	25%	25%	100%	0%
Asset concentration	0%	0%	0%	0%	0%	0%	100%

7.2.1 Equity risk

Equity risk - Stress factors for hybrid debt/preference shares

ICS RC	x%
1-2	4%
3	6%
4	11%
5	21%
6-7	35%

Equity risk - Absolute stress factors for implied volatilities

Maturity (months)	x%
0-1	42%
3	28%

Maturity (months)	x%
6	23%
12	20%
24	17%
36	16%
48	15%
60	14%
84	14%
120	12%
144	11%
180	10%
240	7%
300	4%
360 and above	0%

Equity risk - correlation matrix

Equity segment	Developed	Emerging	Hybrid/preferred	Other
Developed	100%	75%	100%	75%
Emerging	75%	100%	75%	75%
Hybrid/preferred	100%	75%	100%	75%
Other	75%	75%	75%	100%

7.2.2 *Currency risk*

Currency risk stress factors

	Against											
Ref Curr	AUD	BRL	CAD	CHF	CLP	CNY	COP	CZK	DKK	EUR	GBP	HKD
AUD	0%	50%	25%	40%	35%	40%	40%	35%	35%	35%	35%	40%
BRL	50%	0%	50%	65%	50%	55%	55%	60%	60%	60%	55%	55%
CAD	25%	50%	0%	35%	30%	25%	35%	35%	30%	30%	30%	25%
CHF	40%	60%	35%	0%	45%	30%	45%	25%	20%	20%	30%	35%
CLP	35%	50%	30%	45%	0%	30%	40%	40%	40%	40%	35%	30%
CNY	35%	55%	25%	35%	30%	0%	35%	35%	30%	30%	25%	5%
COP	40%	55%	35%	50%	40%	35%	0%	45%	45%	45%	40%	35%
CZK	35%	55%	35%	30%	40%	35%	45%	0%	15%	15%	30%	35%
DKK	35%	55%	30%	20%	35%	30%	40%	15%	0%	2%	25%	30%
EUR	35%	55%	30%	20%	35%	30%	40%	15%	2%	0%	25%	30%
GBP	35%	55%	30%	30%	35%	25%	40%	30%	25%	25%	0%	25%
HKD	35%	55%	25%	35%	30%	5%	35%	35%	30%	30%	25%	0%
HUF	40%	60%	40%	35%	45%	45%	50%	25%	25%	25%	35%	45%
IDR	45%	60%	40%	50%	45%	35%	45%	50%	45%	45%	45%	35%
ILS	35%	55%	30%	35%	35%	25%	35%	35%	30%	30%	30%	25%
INR	35%	50%	25%	35%	30%	20%	35%	35%	30%	30%	30%	15%
JPY	50%	65%	40%	35%	45%	30%	50%	45%	35%	35%	40%	30%
KRW	30%	50%	25%	40%	30%	25%	35%	35%	35%	35%	30%	25%
MXN	35%	50%	30%	45%	35%	30%	35%	40%	40%	40%	40%	30%
MYR	35%	50%	25%	35%	30%	15%	30%	35%	30%	30%	25%	15%
NOK	35%	55%	30%	30%	40%	35%	40%	25%	20%	20%	30%	35%
NZD	20%	55%	30%	40%	40%	40%	45%	40%	35%	35%	35%	40%
PEN	35%	50%	25%	35%	30%	15%	30%	35%	30%	30%	30%	15%
PHP	35%	50%	25%	35%	30%	15%	35%	35%	30%	30%	30%	15%
PLN	35%	55%	35%	40%	40%	40%	45%	25%	25%	25%	35%	40%
RON	35%	50%	35%	30%	40%	30%	45%	25%	20%	20%	30%	30%
RUB	45%	60%	40%	50%	40%	35%	45%	45%	40%	40%	45%	35%
SAR	40%	55%	25%	35%	30%	5%	35%	35%	30%	30%	25%	2%
SEK	35%	55%	30%	30%	40%	35%	45%	25%	20%	20%	30%	35%
SGD	30%	50%	20%	30%	30%	15%	30%	30%	25%	25%	25%	15%
THB	35%	55%	30%	35%	30%	20%	35%	35%	30%	30%	30%	20%
TRY	70%	75%	70%	75%	70%	70%	75%	70%	70%	70%	70%	70%
TWD	35%	50%	25%	30%	30%	10%	35%	35%	25%	25%	25%	10%
USD	40%	55%	25%	35%	30%	5%	35%	35%	30%	30%	25%	2%
ZAR	45%	60%	45%	55%	50%	55%	55%	50%	50%	50%	50%	55%

	Against											
Ref Curr	HUF	IDR	ILS	INR	JPY	KRW	MXN	MYR	NOK	NZD	PEN	PHP
AUD	40%	45%	35%	35%	50%	30%	35%	35%	35%	20%	40%	35%
BRL	60%	60%	55%	55%	70%	50%	50%	50%	55%	55%	55%	55%
CAD	40%	40%	30%	25%	40%	25%	30%	25%	30%	30%	25%	25%
CHF	35%	50%	35%	35%	35%	40%	45%	35%	25%	40%	35%	35%
CLP	45%	45%	35%	30%	45%	30%	35%	30%	40%	40%	30%	30%
CNY	45%	35%	25%	15%	30%	25%	30%	15%	35%	40%	15%	15%
COP	50%	45%	35%	35%	50%	35%	35%	30%	40%	45%	35%	35%
CZK	25%	50%	35%	35%	45%	35%	40%	35%	25%	40%	35%	35%
DKK	25%	45%	30%	30%	35%	30%	40%	30%	20%	35%	30%	30%
EUR	25%	45%	30%	30%	35%	35%	40%	30%	20%	35%	30%	30%
GBP	35%	45%	30%	30%	40%	30%	35%	25%	30%	35%	30%	30%
HKD	45%	35%	25%	15%	30%	25%	30%	15%	35%	40%	15%	15%
HUF	0%	55%	40%	40%	55%	40%	45%	40%	30%	40%	45%	45%
IDR	55%	0%	40%	35%	50%	40%	45%	35%	45%	50%	35%	35%
ILS	40%	40%	0%	25%	40%	30%	30%	25%	35%	40%	25%	25%
INR	40%	35%	25%	0%	35%	25%	30%	20%	35%	35%	20%	20%
JPY	50%	50%	40%	35%	0%	40%	50%	35%	40%	50%	35%	35%
KRW	40%	40%	30%	25%	40%	0%	30%	25%	35%	35%	25%	25%
MXN	45%	45%	35%	30%	50%	30%	0%	25%	40%	40%	30%	30%
MYR	40%	35%	25%	20%	35%	25%	25%	0%	30%	35%	20%	20%
NOK	30%	45%	35%	35%	40%	35%	40%	30%	0%	35%	35%	35%
NZD	40%	50%	40%	35%	50%	35%	40%	35%	35%	0%	40%	40%
PEN	45%	35%	25%	20%	35%	25%	30%	20%	35%	40%	0%	20%
PHP	40%	35%	25%	20%	35%	25%	30%	20%	35%	35%	20%	0%
PLN	25%	50%	40%	40%	55%	35%	40%	40%	30%	40%	40%	40%
RON	30%	45%	30%	30%	40%	35%	40%	30%	30%	40%	35%	35%
RUB	50%	50%	40%	35%	50%	40%	40%	35%	40%	50%	35%	40%
SAR	45%	35%	25%	15%	30%	25%	30%	15%	35%	40%	15%	15%
SEK	25%	45%	35%	35%	45%	35%	40%	30%	20%	35%	35%	35%
SGD	35%	35%	20%	15%	30%	20%	30%	15%	25%	30%	15%	15%
THB	40%	35%	25%	20%	35%	25%	35%	20%	35%	35%	20%	20%
TRY	70%	75%	70%	70%	75%	70%	70%	70%	70%	70%	70%	70%
TWD	40%	35%	25%	15%	30%	20%	30%	15%	30%	35%	15%	15%
USD	45%	35%	25%	15%	30%	25%	30%	15%	35%	40%	15%	15%
ZAR	50%	60%	50%	50%	65%	45%	50%	45%	45%	50%	50%	50%

	Against											

Ref Curr	PLN	RON	RUB	SAR	SEK	SGD	THB	TRY	TWD	USD	ZAR
AUD	35%	40%	45%	40%	35%	30%	35%	55%	35%	40%	45%
BRL	55%	50%	60%	55%	55%	50%	55%	70%	55%	55%	65%
CAD	35%	30%	40%	25%	30%	20%	30%	55%	25%	25%	45%
CHF	35%	30%	45%	35%	30%	25%	35%	65%	30%	35%	55%
CLP	40%	40%	40%	30%	40%	30%	35%	60%	30%	30%	50%
CNY	40%	30%	35%	5%	35%	15%	20%	60%	10%	5%	50%
COP	45%	45%	45%	35%	45%	35%	35%	60%	35%	35%	55%
CZK	25%	25%	45%	35%	25%	30%	35%	60%	35%	35%	50%
DKK	25%	20%	40%	30%	20%	25%	30%	60%	25%	30%	50%
EUR	25%	20%	40%	30%	20%	25%	30%	60%	25%	30%	50%
GBP	35%	30%	40%	25%	30%	25%	30%	60%	25%	25%	50%
HKD	40%	30%	35%	2%	35%	15%	20%	60%	10%	2%	55%
HUF	25%	30%	50%	45%	25%	35%	40%	60%	40%	45%	50%
IDR	50%	45%	50%	35%	45%	35%	35%	70%	35%	35%	60%
ILS	35%	30%	40%	25%	35%	20%	25%	55%	25%	25%	50%
INR	40%	30%	35%	15%	35%	15%	20%	55%	15%	15%	50%
JPY	50%	40%	50%	30%	40%	30%	35%	70%	30%	30%	65%
KRW	35%	35%	40%	25%	35%	20%	25%	55%	20%	25%	45%
MXN	40%	40%	40%	30%	40%	30%	35%	60%	30%	30%	50%
MYR	35%	30%	35%	15%	30%	15%	20%	55%	15%	15%	45%
NOK	30%	30%	40%	35%	20%	25%	35%	60%	30%	35%	45%
NZD	40%	40%	50%	40%	35%	30%	35%	60%	35%	40%	50%
PEN	40%	30%	35%	15%	35%	15%	20%	60%	15%	15%	50%
PHP	40%	30%	40%	15%	35%	15%	20%	55%	15%	15%	50%
PLN	0%	30%	45%	40%	30%	35%	40%	55%	40%	40%	50%
RON	30%	0%	40%	30%	25%	25%	35%	60%	30%	30%	50%
RUB	45%	40%	0%	35%	45%	35%	40%	65%	35%	40%	55%
SAR	40%	30%	35%	0%	35%	15%	20%	60%	10%	2%	55%
SEK	30%	25%	45%	35%	0%	30%	35%	60%	30%	35%	50%
SGD	35%	25%	35%	15%	30%	0%	15%	55%	10%	15%	45%
THB	40%	30%	40%	20%	35%	15%	0%	55%	20%	20%	50%
TRY	70%	70%	75%	70%	70%	65%	70%	0%	70%	70%	75%
TWD	35%	30%	35%	10%	30%	10%	20%	55%	0%	10%	50%
USD	40%	30%	35%	2%	35%	15%	20%	60%	10%	0%	55%
ZAR	50%	50%	55%	55%	50%	45%	50%	60%	50%	55%	0%

7.3 Credit risk

The following tables contain the ICS Credit risk stress factors for the exposure classes by ICS risk category (ICS RC) and maturity:

Credit risk stress factors for corporates and reinsurance

ICS RC	Maturity: 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14+
1 or 2	0.2%	0.7%	0.9%	1.2%	1.4%	1.6%	1.7%	1.9%	2.0%	2.1%	2.2%	2.3%	2.4%	2.4%	2.5%
3	0.6%	1.3%	1.6%	1.8%	2.1%	2.3%	2.6%	2.8%	3.0%	3.2%	3.3%	3.4%	3.5%	3.6%	3.7%
4	1.4%	3.0%	3.6%	4.1%	4.5%	4.9%	5.1%	5.3%	5.4%	5.6%	5.7%	5.8%	5.9%	6.0%	6.0%
5	3.6%	7.1%	8.3%	9.0%	9.4%	9.7%	9.8%	9.8%	9.8%	9.8%	9.8%	9.8%	9.8%	9.8%	9.8%
6	8.9%	14.4 %	15.3 %	15.6 %	15.6 %	15.6 %	15.6 %	15.6 %	15.6 %	15.6 %	15.6 %	15.6 %	15.6 %	15.6 %	15.6 %
7	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Unrated	6.3%	10.7 %	11.8 %	12.3 %	12.5 %	12.6 %	12.7 %	12.7 %	12.7 %	12.7 %	12.7 %	12.7 %	12.7 %	12.7 %	12.7 %
In Default	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%

Credit risk stress factors for public sector entities

ICS RC	Maturity: 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14+
1 or 2	0.1%	0.4%	0.5%	0.6%	0.7%	0.8%	0.9%	1.0%	1.0%	1.1%	1.1%	1.2%	1.2%	1.2%	1.3%
3	0.4%	1.0%	1.3%	1.5%	1.8%	2.0%	2.2%	2.4%	2.5%	2.7%	2.8%	2.9%	3.0%	3.0%	3.1%
4	1.0%	2.2%	2.6%	3.0%	3.3%	3.6%	3.9%	4.1%	4.2%	4.4%	4.5%	4.6%	4.7%	4.8%	4.9%
5	2.5%	5.1%	6.0%	6.6%	7.0%	7.3%	7.5%	7.6%	7.6%	7.7%	7.8%	7.8%	7.9%	7.9%	7.9%
6	6.3%	10.8 %	11.8 %	12.3 %	12.5 %	12.7 %	12.7 %	12.7 %	12.7 %	12.7 %	12.7 %	12.7 %	12.7 %	12.7 %	12.7 %

7	22.0%	24.7%	25.2%	25.3%	25.3%	25.3%	25.3%	25.3%	25.3%	25.3%	25.3%	25.3%	25.3%	25.3%	25.3%
Unrated	2.5%	5.1%	6.0%	6.6%	7.0%	7.3%	7.5%	7.6%	7.6%	7.7%	7.8%	7.8%	7.9%	7.9%	7.9%
In Default	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%

Credit risk stress factors for infrastructure

ICS RC	Maturity: 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14+
1 or 2	0.2%	0.7%	0.9%	1.2%	1.4%	1.6%	1.7%	1.9%	2.0%	2.1%	2.2%	2.3%	2.4%	2.4%	2.5%
3	0.6%	1.3%	1.6%	1.8%	2.1%	2.3%	2.6%	2.8%	3.0%	3.2%	3.3%	3.4%	3.5%	3.6%	3.7%
4	1.4%	3.0%	3.6%	4.1%	4.5%	4.9%	5.1%	5.3%	5.4%	5.6%	5.7%	5.8%	5.9%	6.0%	6.0%
5	3.6%	7.1%	8.3%	9.0%	9.4%	9.7%	9.8%	9.8%	9.8%	9.8%	9.8%	9.8%	9.8%	9.8%	9.8%
6	8.9%	14.4%	15.3%	15.6%	15.6%	15.6%	15.6%	15.6%	15.6%	15.6%	15.6%	15.6%	15.6%	15.6%	15.6%
7	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Unrated	4.7%	8.0%	8.9%	9.2%	9.4%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%
In Default	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%

Credit risk stress factors for securitisations

ICS RC	Maturity: 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14+
1 or 2	0.2%	0.7%	0.9%	1.2%	1.4%	1.6%	1.7%	1.9%	2.0%	2.1%	2.2%	2.3%	2.4%	2.4%	2.5%
3	0.6%	1.3%	1.6%	1.8%	2.1%	2.3%	2.6%	2.8%	3.0%	3.2%	3.3%	3.4%	3.5%	3.6%	3.7%
4	1.4%	3.0%	3.6%	4.1%	4.5%	4.9%	5.1%	5.3%	5.4%	5.6%	5.7%	5.8%	5.9%	6.0%	6.0%
5	10.8%	21.3%	24.9%	27.0%	28.2%	29.1%	29.4%	29.4%	29.4%	29.4%	29.4%	29.4%	29.4%	29.4%	29.4%

6	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
7	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Unrated	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
In Default	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Credit risk stress factors for re-securitisations

ICS RC	Maturity: 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14+
1 or 2	0.4%	1.4%	1.8%	2.4%	2.8%	3.2%	3.4%	3.8%	4.0%	4.2%	4.4%	4.6%	4.8%	4.8%	5.0%
3	1.2%	2.6%	3.2%	3.6%	4.2%	4.6%	5.2%	5.6%	6.0%	6.4%	6.6%	6.8%	7.0%	7.2%	7.4%
4	2.8%	6.0%	7.2%	8.2%	9.0%	9.8%	10.2%	10.6%	10.8%	11.2%	11.4%	11.6%	11.8%	12.0%	12.0%
5	21.6%	42.6%	49.8%	54.0%	56.4%	58.2%	58.8%	58.8%	58.8%	58.8%	58.8%	58.8%	58.8%	58.8%	58.8%
6	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
7	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Unrated	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
In Default	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Mortgage Loans

Commercial and agricultural mortgages where repayment depends on property income

Depending on data availability, the risk charge is calculated using one of the three following methods, in decreasing order of preference:

a. Method 1: risk charge based on the ICS Commercial Mortgage (CM) category as determined by loan-to-value (LTV) and debt service coverage ratio (DSCR);

b. Method 2: risk charge based on the ICS CM category as determined by LTV only; or

c. Method 3: no Credit Quality Differentiator used.

Stress factors for agricultural and commercial mortgages, Method 1

ICS CM Categories	Stress factors
CM1	4.8%
CM2	6.0%
CM3	7.8%
CM4	15.8%
CM5	23.5%
CM6	35%
CM7	35%

Stress factors for agricultural and commercial mortgages, Method 2

ICS CM Categories	Stress factors	LTV Minimum	LTV Maximum
CM1	4.8%	0%	59%
CM2	6.0%	60%	79%
CM3	7.8%	80%	99%
CM4	15.8%	100%	NA
CM5	Not applicable		
CM6	35%		
CM7	35%		

For agricultural and commercial Method 3, where LTV and DSCR data are not available, a flat 8% stress factor is used.

Commercial and agricultural mortgages where repayment does not depend on property income

When the LTV ratio of the mortgage is above 60%, the risk factor is that of a regular credit exposure to the borrower. When the LTV ratio of the mortgage is 60% or lower, the risk factor is the lower of 3.6% or the risk factor for a regular credit exposure to the borrower.

Residential mortgages

For performing residential mortgage loans for which repayment depends on income generated by the underlying property, the factors applied are based on the mortgage's LTV ratio, as specified in the following table:

Factors for residential mortgages for which repayment depends on income generated by the underlying property

LTV	Stress factors
LTV ≤ 60%	4.2%
60% < LTV ≤ 80%	5.4%
LTV > 80%	7.2%

For performing residential mortgage loans for which repayment does not depend on income generated by the underlying property, the factors applied are based on the mortgage's LTV ratio, as specified in the following table:

Factors for residential mortgages for which repayment does not depend on income generated by the underlying property

LTV	Stress factors
LTV ≤ 40%	1.5%
40% < LTV ≤ 60%	1.8%
60% < LTV ≤ 80%	2.1%
80% < LTV ≤ 90%	2.7%
90% < LTV ≤ 100%	3.3%
LTV > 100%	4.5%

For non-performing mortgage loans, the factor applied is 35%.

Other factors

- The stress factor for policy loans is 0%.
- The stress factor for short-term obligations of regulated banks is 0.4%.
- The stress factor for receivables from agents and brokers is 6.3%.
- All other assets receive a stress factor of 8%.
- The credit equivalent amount for OTC derivatives is calculated using the current exposure method from Annex 4, section VII of the Basel Framework[19].

[19] Accessible at http://www.bis.org/publ/bcbs128.pdf

7.4 Aggregation/Diversification of ICS risk charges

Aggregation matrix between risks

	Life	Non-life	Catastrophe	Market	Credit
Life	100%	0%	25%	25%	25%
Non-life	0%	100%	25%	25%	25%
Catastrophe	25%	25%	100%	25%	25%
Market	25%	25%	25%	100%	25%
Credit	25%	25%	25%	25%	100%