BMA
BERMUDA MONETARY AUTHORITY

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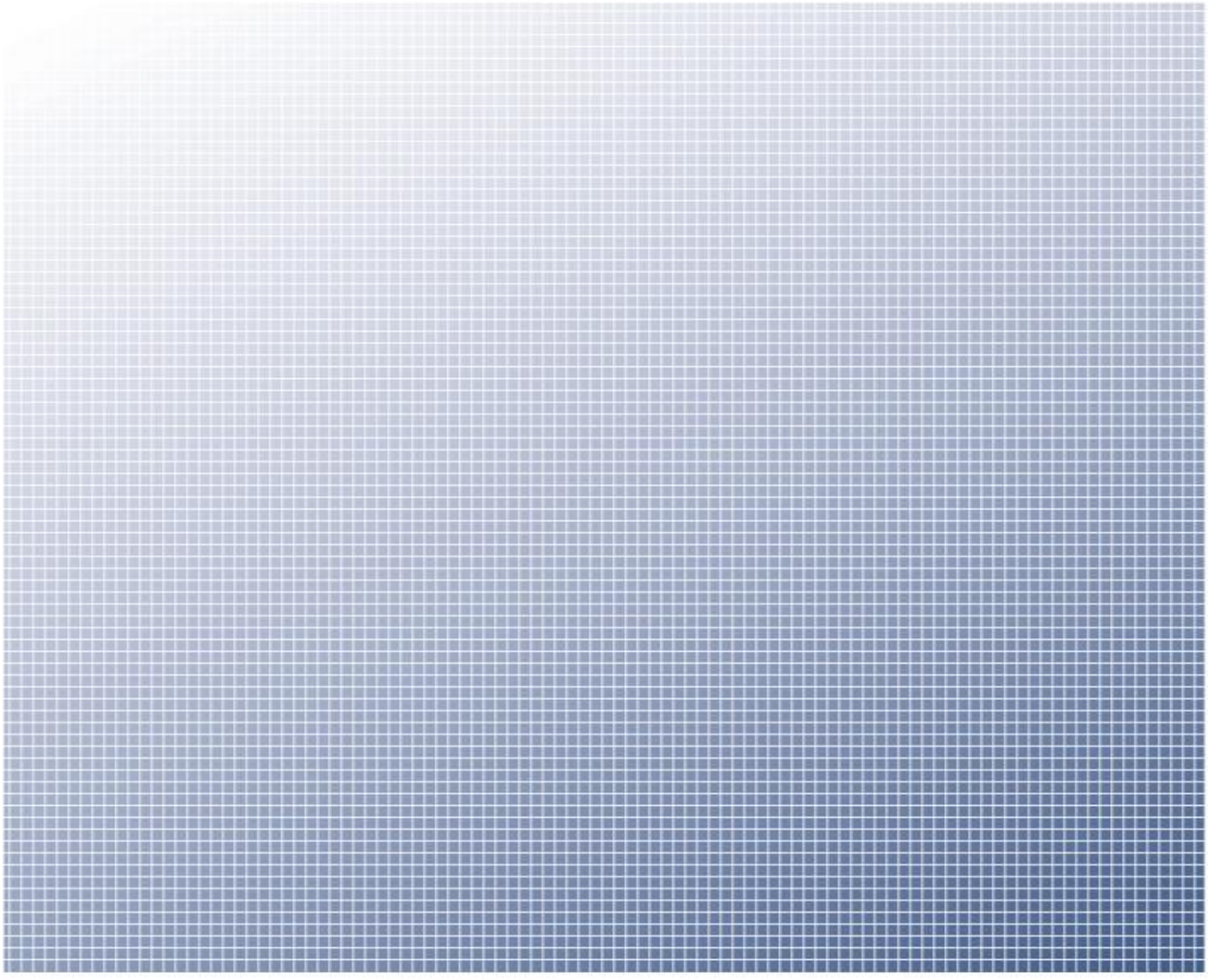
Bermuda Monetary Authority

Catastrophe Risk Modelling

2023 Report



Foreword

Bermuda is predominantly an insurance-based international financial centre, specialising in catastrophe reinsurance and many other insurance risks. It is home to one of the largest reinsurance markets globally.

With a relatively high concentration of catastrophe risk underwritten in Bermuda, a broad understanding of catastrophe modelling practices is central to the Bermuda Monetary Authority's (Authority or BMA) supervisory framework. As insurers rely significantly upon both internally built models and external vendor models to assess catastrophe exposures, this information is also important to Bermuda insurers, other stakeholders and insurance markets around the globe.

Recognising Bermuda's important position as a leader in the catastrophe market and the BMA’s role in regulating the market, the Authority publishes this report annually. It offers an overview of the catastrophe modelling practices in Bermuda and reaffirms our commitment to maintaining high standards of transparency.

Ricardo Garcia
Managing Director, Supervision

Modelling Practices Report

This is the Authority's fifth stand-alone annual Catastrophe Risk Modelling Report. The content of this report is the result of analyses carried out by the BMA staff and includes data from both insurers and (re)insurers.

About the BMA

The BMA was established by statute in 1969. Its role has evolved over the years to meet the changing needs in Bermuda's financial services sector. Today, it supervises, regulates and inspects financial institutions operating in the jurisdiction. It also issues Bermuda's national currency, manages exchange control transactions, assists other authorities with detecting and preventing financial crime and advises the Government on banking and other financial and monetary matters.

The Authority develops risk-based financial regulations that apply to the supervision of Bermuda's banks, trust companies, investment businesses, investment funds, fund administrators, money service businesses, corporate service providers, insurance companies, digital asset issuances and digital asset businesses. It also regulates the Bermuda Stock Exchange and the Bermuda Credit Union.

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This publication is available on the BMA website: www.bma.bm

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ACRONYMS

AAL	Average Annual Loss
AIR	AIR Worldwide
AMO	Atlantic Multi-decadal Oscillation
Authority	Bermuda Monetary Authority
BMA	Bermuda Monetary Authority
BSCR	Bermuda Solvency Capital Requirement
Cat	Catastrophe
Cat Return	Catastrophe Risk Return and Schedule of Risk Management
CSR	Capital and Solvency Return
EQECAT	Catastrophe Risk Management (CoreLogic)
EP	Exceedance Probability
IFC	International Financial Centre
Mph	Miles per hour
PML	Probable Maximum Loss
RMS	Risk Management Solutions
RDS	Realistic Disaster Scenarios
SPI	Special Purpose Insurer
SST	Sea Surface Temperatures
TVaR	Tail Value at Risk

I. EXECUTIVE SUMMARY

This report highlights the Catastrophe (Cat) modelling practices of Bermuda (re)insurers. (Re)insurers rely substantially on models to project losses and assist them in risk and solvency calculations. In its prudential supervisory work, the Authority tracks trends in the usage of models to form views and supervisory responses in managing Cat risk.

In 2023, Bermuda legal entities' average loading factor in the accumulation process increased for the fifth consecutive time to 12.30%, compared to 10.57% in 2022. The increase in the loading factor within the last two years was primarily driven by increasing claims costs and the uncertainty of the impact of climate change on the frequency and severity of natural catastrophes that might not yet be fully reflected in the models. The average loading factor for groups stood at 10.68% in 2023, compared to 9.10% in 2022. About 70% of Bermuda legal entities and groups utilise the Atlantic Multi-decadal Oscillation (AMO) near-term view of exposure.

AIR Worldwide (AIR) and Risk Management Solutions (RMS) are the most frequently used modelling software tools (used together or stand-alone), with AIR being the leading model for legal entities and groups. In-house modelling[1] was utilised by 41.7% of legal entities and 31.6% of groups in 2023. Additionally, 12.8% of legal entities and 5.9% of groups reported using more than one model in their accumulations. Legal entities mostly use their models every quarter, with 54.2% of insurers doing so, while 42.1% of groups accumulate data on a quarterly basis.

[1] An in-house model is a proprietary model built by an insurer.

II. INTRODUCTION

Bermuda's insurance sector is regulated and supervised by the BMA. As part of its regulatory and supervisory measures, the Authority requires all Class 3B and Class 4 insurers to submit a Capital and Solvency Return (CSR). This includes a Catastrophe Risk Return and Schedule of Risk Management (together 'Cat Return') as part of their annual statutory filing, detailing the insurers' Cat risk management practices.

The global insurance market, particularly, the Bermuda market, significantly relies upon vendor models to assess Cat exposures. If the vendor models underestimate potential losses arising from events, the industry as whole may have their capital levels impacted. The Authority expects insurers to have a thorough understanding of these vendor models; therefore, the monitoring of modelling practices in Bermuda is a key aspect of the Authority's supervisory framework.

This report contributes to the understanding of Bermuda as an insurance-based International Financial Centre (IFC) and a leader in regulating the Cat (re)insurance market. Ultimately, this report demonstrates the contribution of Bermuda's natural Cat risk mitigation to the global capacity for risk-taking while also emphasising the Authority's commitment to high standards of transparency.

III. METHODOLOGY

This report was produced using aggregated and non-aggregated data from the Bermuda Capital and Solvency Return (CSR) filings of Class 3B and Class 4 legal entities and insurance groups for the period ending 31 December 2023[2]. Specifically, the following schedules from the CSR were used as data sources:

- Schedule X(e) – Cat Risk Return: Accumulations Overview
- Schedule X(f) – Cat Risk Return: Data Analysis

The exclusion of other insurer classes, such as Special Purpose Insurers (SPI)[3], limits the conclusions that can be made from the results of this survey. Therefore, the results reflect one industry segment and not the entire exposure of the Bermuda insurance market.[4]. This report also does not consider mortality a catastrophic risk, as long-term (life) insurers are not included in the analysis.

The accumulation process analysis is based on insurer responses in 2022 and previous years' CSR filings. It provides insights into the relationship between insurers' modelling practices and the actual management of those risks from an operational point of view.

[2] Not all insurers have 31 December year ends, therefore, the data used in the report may not fully reconcile with other BMA publications.
[3] SPIs are significant contributors to Cat risks underwritten in Bermuda. Their details are included in the BMA's annually published Alternative Capital Report.
[4] The Bermuda insurance market includes the Bermuda (re)insurance market.

The analyses in this report were based only on original CSR data input. Although other documents are separately required for the CSR filing, no reference was made to them for the purposes of this report. The Authority's supervisory team reviews these additional documents at the micro level in the context of individual insurers. However, the analysis for this report did not reflect the subtle nuances provided by an insurer's full return that might otherwise impact these results.

Information Box

Class 3B and Class 4 insurers are the largest property and casualty commercial insurers in Bermuda's market. They are required to maintain statutory capital and surplus of at least 99% Tail Value at Risk (TVaR) over a one-year time horizon.

Aggregate Statistics for Classes 3B and 4, 2023 (In US$ billions)

Net Written Premiums	68.9
Net Income	25.2
Total Claims	35.5
Total Assets	315.2

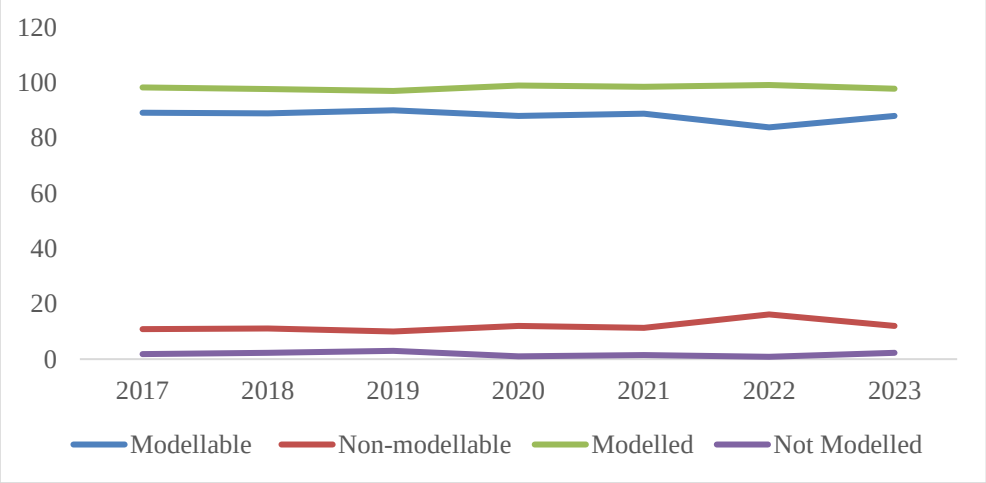
Source: BMA

IV. PROBABLE MAXIMUM LOSS AND ACCUMULATION PROCESS

The accumulation process is an important component of the modelling process and is integral to the insurer's risk management framework. In Bermuda, the accumulation of Cat risks is a multifaceted risk management process. Insurers' modelling practices are a portion of this accumulation process. As part of the CSR filing, the Authority annually collects information about the accumulation process from companies' prudential filings.

The 2023 CSR filing showed that 88.0% of the Cat risk exposure underwritten in Bermuda is modellable.[5] Using vendor Cat models and that 99.15% of Cat risks were modelled[6]. While the percentage of modellable exposure has increased slightly compared to 2022, the percentage of modelled exposure remained steady[7].

Figure 1. Modellable and Modelled Exposure (In per cent)



Source: BMA staff calculations

[5] Modellable exposure refers to the exposure that can be simulated through a vendor Cat model. Non-modellable exposure refers to exposure that cannot be simulated through a vendor Cat model or when there are no Cat models that assess the risk of the region peril under consideration. Modelled exposure refers to risks that the insurer modelled. When exposures are not modellable through the use of vendor Cat models (i.e., non-modellable exposure), insurers often use models developed in-house to evaluate risk. As such, very few exposures are 'not modelled'.

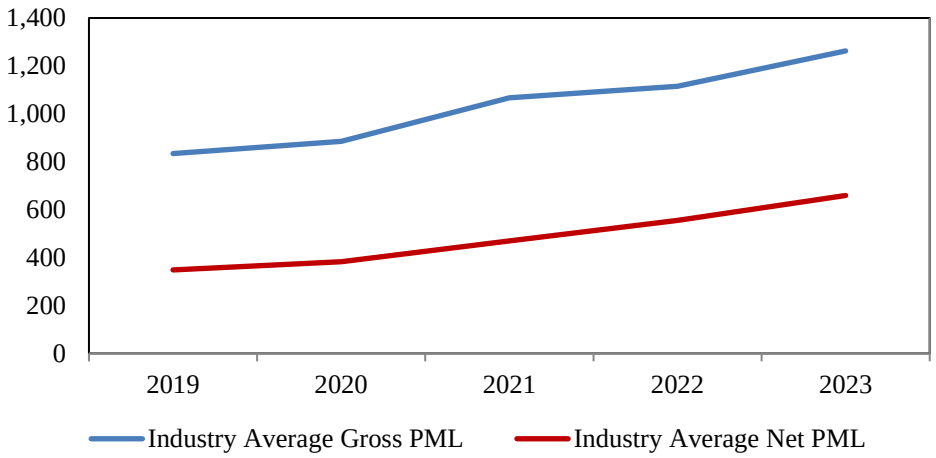
[6] Reasons for non-modelled risk may include data limitations that prevent the exposure from being run through a vendor or in-house Cat model. This may be due to: 1) lack of resolution of the data or lack of completeness of the data, which renders the data insufficient to produce credible modelled results; 2) model deficiency, where the model is deemed to be inadequate to produce credible results; and/or 3) there is no accessible model to assess the peril under consideration.

[7] The 2023 CSR filing showed that 88.72% of the Cat risk exposure underwritten in Bermuda is modellable using vendor Cat models and that 97.77% of Cat risks were modelled.

A. PROBABLE MAXIMUM LOSSES AND ACCUMULATION PROCESS - LEGAL ENTITIES

This section presents aggregated results from the statutory filings of insurers for 2023. Bermuda Class 3B and Class 4 insurers are required to file the Catastrophe Risk Schedule, a questionnaire addressing modelling practices. The Catastrophe Risk Schedule also includes quantitative information about catastrophe exposures. With respect to quantitative metrics, Bermuda insurers report metrics on the Average Annual Loss (AAL), Probable Maximum Loss (PML) and factor loadings. The latest data is displayed in the following figures and tables. The PML is defined as the 99% Tail Value at Risk (TVaR) on an aggregate basis.

Figure 2. Gross and Net Average Industry PML (In US$ millions)



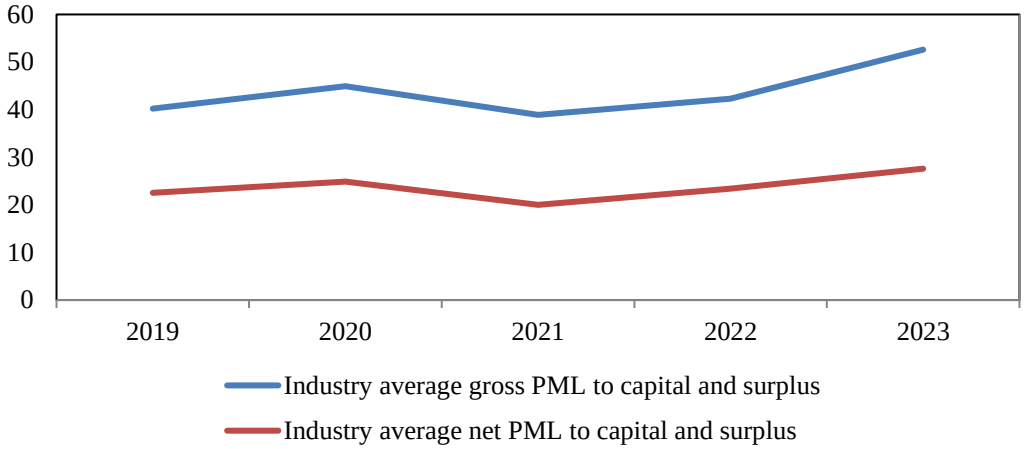
Source: BMA staff calculations

Table 1: PML (In US$ millions)

	2023	2022	2021	2020	2019
Industry Average Gross PML	1,262.7	1,115.1	1,066.4	885.8	834.2
Industry Average Net PML	659.3	555.2	469.6	382.7	348.5

Source: BMA staff calculations

Figure 3. Gross and Net Industry PML to Capital and Surplus (In per cent)



Source: BMA staff calculations

Table 2: PML Ratios (In per cent)

	2023	2022	2021	2020	2019
Industry Average Gross PML to Capital and Surplus	52.6	42.3	38.9	44.9	40.2
Industry Average Net PML to Capital and Surplus	27.6	23.4	20.0	24.9	22.5

Source: BMA staff calculations. The sample removes certain outliers that distort the ratios.

Table 1 represents the average PML for legal entities in dollar amounts. The average PML for 2023 increased 13.2% on a gross and 18.7% on a net basis compared to 2022.

Table 2 presents gross and net PML ratios to capital and surplus. This ratio indicates whether the available capital and surplus can withstand a loss equal to 99% TVaR. On a gross basis, in 2023, a 99% TVaR aggregate loss was expected to consume 52.6% of available capital and surplus. On a net basis, a 99% TVaR aggregate loss was expected to consume 27.6% of available capital and surplus. Both ratios increased year over year, reflecting the higher level of retained exposure relative to increasing available capital and surplus.

Table 3 presents the average loading factors used as add-ons to the output of catastrophe modelling. These factors allow insurers to incorporate their view of risk, adjust for model error and reflect conservatism into the modelling and or aggregation process, and they are applied to the PML. For example, if the Cat model yields a PML of US$100, a 5% factor would raise the PML to US$105. Note that insurers provide an average loading factor[8], whereas loading factors can be applied by region, peril, frequency and/or severity.

Table 3: Loading Factors (In per cent)

	2023	2022	2021	2020	2019
Average Loading Factor	12.3	10.6	9.3	6.6	6.1

Source: BMA staff calculations

In 2023, the average loading factor reached 12.3%, representing the fifth consecutive increase over the prior five years. Over time, vendor models strive to become more accurate while also becoming more conservative, thus reducing the need for higher safety buffers. However, the 2023 average loading factor increase reflects the continued risk of pricing challenges with a persistent higher-than-average inflationary environment and an increase in severity and frequency of Cat events, among other climate change-related developments that might not yet be reflected in the models.

The loading factor is estimated using variations of an analytical portfolio approach, where insurers analyse the model's total output and back-test the results according to the total loss experience, or a per-risk view that blends the experience of single lines of business into the total portfolio PML. The responses can be found in Table 4.

Table 4: Loading Factor Estimation Methods (In per cent of respondents)

	2023	2022	2021	2020	2019
Determined Analytically	40.5	40.5	41.0	35.7	43.6
Estimated	59.5	59.5	59.0	64.3	56.4

Source: BMA staff calculations

In 2023, 59.5% of insurers estimated the loading factor, while 40.5% determined it analytically through modelling, the same proportion as in 2022.

Another interesting modelling practice is the usage of AMO. AMO refers to the alteration of Sea Surface Temperatures (SST) in the Northern Atlantic Ocean from cool to warm phases that last several years. Since

[8] The loadings reflect the cumulative loading regardless of the level applied (i.e., within the accumulation process or post the accumulation process/applied to the PML). The same applies for legal entities and groups.

the mid-1990s, a warm phase has existed. A correlation has been observed between warm SSTs and increased frequency of severe hurricanes and other destructive weather phenomena. Based on both near-term and long-term views, Bermuda insurers were asked whether they consider loading for this risk factor.

Table 5. AMO Factor Consideration (In percent of respondents)

	2023	2022	2021	2020	2019
Near-term Frequency	72.9	73.5	68.9	64.6	61.7
Long-term Frequency	27.1	26.5	31.1	35.4	38.3

Source: BMA staff calculations

In 2023, 72.9% of insurers utilised the near-term AMO factor to model Atlantic hurricane exposures, while 27.1% utilised the long-term factor. The AMO factor relates to trends in hurricane frequencies considered in modelling Atlantic hurricane exposures and the financial losses that stem from hurricane activity.

The questionnaire inquired about the vendors used to determine whether insurers based their modelling opinions on one or multiple models. This question allows the identification of the more prevalent Cat model vendors in the market. In addition, the questionnaire also asks how frequently insurers perform portfolio modelling (or, as the BMA refers to it, 'accumulations') and whether insurers develop their models separately from vendor models. The following table summarises the responses.

Table 6: Vendor Model Usage and Licensing (In per cent of respondents)

Model Usage	**2023**	**2022**	**2021**	**2020**	**2019**
AIR Only	42.4	46.7	37.5	37.1	20.9
EQECAT Only	0.0	0.0	0.0	0.0	0.0
RMS Only	27.3	36.7	28.1	34.3	32.6
AIR and RMS	30.3	16.7	34.4	28.6	46.5
AIR and EQECAT	0.0	0.0	0.0	0.0	0.0
EQECAT and RMS	0.0	0.0	0.0	0.0	0.0
AIR, EQECAT and RMS	0.0	0.0	0.0	0.0	0.0
Model Licensing	**2023**	**2022**	**2021**	**2020**	**2019**
AIR Only	33.3	37.5	29.5	21.7	14.9
EQECAT Only	0.0	0.0	0.0	0.0	0.0
RMS Only	25.0	25.0	20.5	21.7	21.3
AIR and RMS	41.7	35.4	50.0	54.3	61.7
AIR and EQECAT	0.0	0.0	0.0	0.0	0.0
EQECAT and RMS	0.0	2.1	0.0	2.2	2.1
AIR, EQECAT and RMS	0.0	0.0	0.0	0.0	0.0

Source: BMA staff calculations

AIR is the most used stand-alone model. Moreover, using three models in tandem is the exception, with EQECAT receiving no share of use within the last five years for the insurer category in this report. However, dual licensing of AIR and RMS is common in the market.

Table 7: Model Frequency Usage (In per cent of respondents)

	2023	2022	2021	2020	2019
Ad-hoc	0.0	0.0	0.0	0.0	0.0
Annual	2.1	4.2	2.3	4.3	4.2
Semi-annual	2.1	2.1	0.0	4.3	6.3
Quarterly	54.2	54.2	56.8	41.3	43.8
Monthly	25.0	22.9	20.5	23.9	22.9
Weekly	0.0	0.0	0.0	0.0	0.0
Daily	8.3	10.4	13.6	17.4	14.6
Real-time	8.3	6.3	6.8	8.7	8.3

Source: BMA staff calculations

Insurers use and update Cat modelling in fixed periods, usually quarterly and monthly. Each quarter, renewals or supervisory reporting are the most common reasons to run the Cat models, with 54.2% of insurers reporting quarterly use in 2023, equal to the frequency in 2022. In addition, real-time use increased to 8.3% of insurers in 2023, compared to 6.3% in 2022.

Table 8: Model Frequency and Business Unit Differences
(In per cent of respondents)

	2023	2022	2021	2020	2019
Yes	37.5	32.6	39.5	36.6	40.0
No	62.5	67.4	60.5	63.4	60.0

Source: BMA staff calculations

Insurers were asked whether different business units use Cat models at different frequencies. In 2023, 62.5% of respondents said they do not perform accumulations at different frequencies, compared to 67.4% in 2022.

Table 9: Internal Model Usage (In per cent of respondents)

	2023	2022	2021	2020	2019
Yes	41.7	37.5	36.4	41.3	39.6
No	58.3	62.5	63.6	58.7	60.4

Source: BMA staff calculations

In 2023, 41.7% of insurers developed their stochastic model. Insurers with specialised lines of business outside the cover of traditional vendors are more likely to develop such in-house models to capture their unique risks.

The BMA also asked insurers how their Cat risk modelling reflects their reinsurance and retrocession purchases. The responses are shown in Table 10.

Table 10: External Reinsurance Model Usage (In per cent of respondents)

	2023	2022	2021	2020	2019
The company has minimal Cat exposure protection. Therefore, gross is effectively net	0.0	4.2	2.3	6.8	6.4
The accumulations are calculated on a gross basis with reinsurance protections calculated approximately outside of the system	4.3	2.1	0.0	2.3	4.3
The accumulations are calculated on a gross basis, with reinsurance protections calculated explicitly outside of the system	0.0	4.2	4.7	0.0	2.1
The accumulations are calculated on a gross basis with the effect of reinsurance protections calculated explicitly for some types of protection within the system	48.9	50.0	48.8	45.5	34.0
The accumulations are calculated on a gross basis with the effect of reinsurance protections calculated explicitly for each type of protection within the system	46.8	39.6	44.2	45.5	53.2

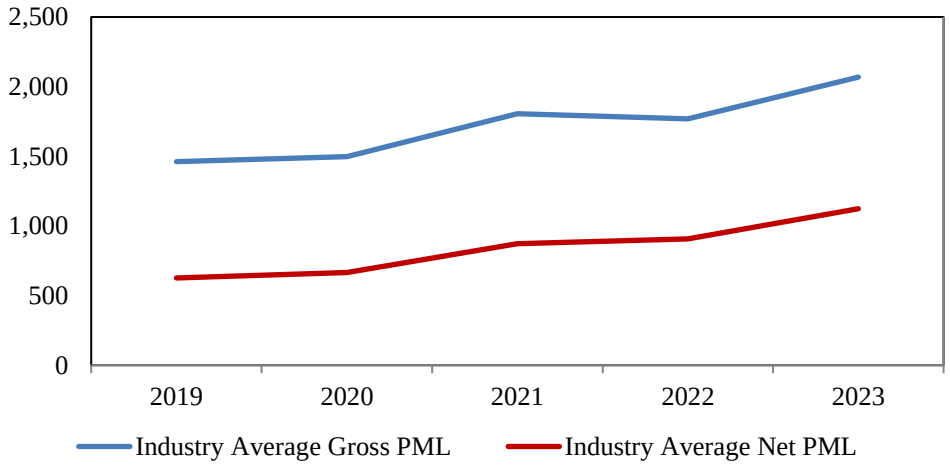
Source: BMA staff calculations

The number of insurers purchasing little or no external Cat reinsurance decreased to 0.0% of respondents in 2023, compared to 4.2% in 2022. The vast majority of insurers model Cat risk by considering external reinsurance explicitly, either for some treaties or separately. In 2023, 95.7% of respondents explicitly calculated some or all external reinsurance treaties in their Cat modelling.

B. PROBABLE MAXIMUM LOSSES AND ACCUMULATION PROCESS - INSURANCE GROUPS

The same data collected for legal entities is also collected from insurance groups.

Figure 4. Gross and Net Average Industry PML (In US$ millions)



Source: BMA staff calculations

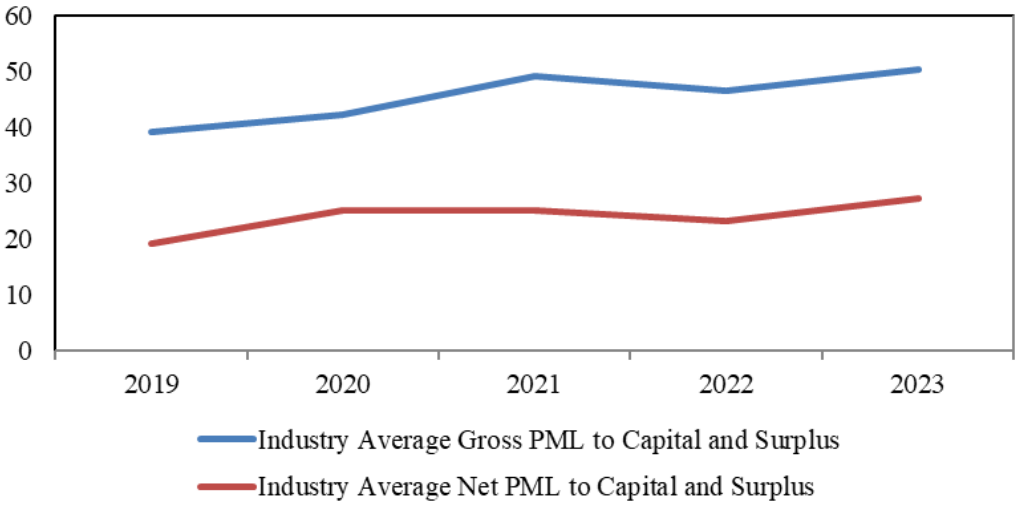
Table 11: PML (In US$ millions)

	2023	2022	2021	2020	2019
Industry Average Gross PML	2,068.5	1,769.9	1,805.1	1,497.6	1,461.7
Industry Average Net PML	1,123.7	906.8	871.9	665.1	626.6

Source: BMA staff calculations

In 2023, the industry average gross exposure increased by 16.9% compared to 2022, with net exposure increasing by 23.9%, showing that insurance groups are retaining more of their gross exposure.

Figure 5. Gross and Net Industry PML to Capital and Surplus (In per cent)



Source: BMA staff calculations

Table 12: PML Ratios (In per cent)

	2023	2022	2021	2020	2019
Industry Average Gross PML to Capital and Surplus	50.3	46.5	49.2	42.4	39.3
Industry Average Net PML to Capital and Surplus	27.3	23.3	25.2	20.3	19.3

Source: BMA staff calculations

As in the case of legal entities, the BMA reports the average loading factors for groups in Table 13.

Table 13: Loading Factors (In per cent)

	2023	2022	2021	2020	2019
Average Loading Factor	10.7	9.1	8.8	4.6	5.5

Source: BMA staff calculations

The loading factor for groups has increased for 2023 compared to 2022. In 2022, the average loading factor was 9.1%, compared to 10.7% in 2023. Similar to the increase seen in the legal entities section, the increase in the average loading factor in the last two years can be attributed to social inflation and the impact of climate change that are not yet reflected in the models.

Table 14 shows how groups establish loading factors, either through estimation or analytical determination. In 2023, as in 2022, 57.9% of groups determined their factors non-analytically by relying on expert judgment.

Table 14: Loading Factor Estimation Methods (In per cent of respondents)

	2023	2022	2021	2020	2019
Determined Analytically	42.1	42.1	41.2	35.3	37.5
Estimated	57.9	57.9	58.8	64.7	62.5

Source: BMA staff calculations

In 2023, 68.4% of groups used near-term frequency of the AMO compared to 71.4% in 2022. Model results converge based on either the near-term or long-term frequency of the AMO factor.

Table 15: AMO Factor Consideration (In per cent of respondents)

	2023	2022	2021	2020	2019
Near-term Frequency	68.4	71.4	68.4	55.6	47.4
Long-term Frequency	31.6	28.6	31.6	44.4	52.6

Source: BMA staff calculations

Table 16 displays the model vendor licensing and usage statistics for groups.

Table 16: Vendor Model Usage (In per cent of respondents)

Model Usage	**2023**	**2022**	**2021**	**2020**	**2019**
AIR Only	52.9	47.4	38.9	31.3	17.6
EQECAT Only	0.0	0.0	0.0	0.0	0.0
RMS Only	17.6	26.3	38.9	43.8	35.3
AIR and RMS	23.5	21.1	22.2	18.8	41.2
AIR and EQECAT	0.0	0.0	0.0	0.0	0.0
EQECAT and RMS	5.9	5.3	0.0	6.3	5.9
AIR, EQECAT and RMS	0.0	0.0	0.0	0.0	0.0
Model Licensing	**2023**	**2022**	**2021**	**2020**	**2019**
AIR Only	42.1	42.9	26.3	21.1	5.9
EQECAT Only	0.0	0.0	0.0	0.0	0.0
RMS Only	21.1	23.8	31.6	31.6	23.5
AIR and RMS	31.6	28.6	42.1	42.1	64.7
AIR and EQECAT	0.0	0.0	0.0	0.0	0.0
EQECAT and RMS	5.3	4.8	0.0	5.3	5.9
AIR, EQECAT and RMS	0.0	0.0	0.0	0.0	0.0

Source: BMA staff calculations

AIR usage continued to make up the largest share in groups, either stand-alone or in combination with other models. Nevertheless, the market remains concentrated between two vendors.

Table 17: Model Frequency Usage (In per cent of respondents)

	2023	2022	2021	2020	2019
Ad-hoc	0.0	0.0	0.0	0.0	0.0
Annual	10.5	14.3	10.5	10.5	10.5
Semi-annual	5.3	4.8	5.3	5.3	10.5
Quarterly	42.1	38.1	42.1	42.1	42.1
Monthly	31.6	28.6	26.3	26.3	21.1
Weekly	0.0	0.0	0.0	0.0	0.0
Daily	5.3	9.5	15.8	15.8	15.8
Real-time	5.3	4.8	0.0	0.0	0.0

Source: BMA staff calculations

Accumulation frequency follows a similar pattern for groups and legal entities as well. Most groups perform accumulations quarterly, as 42.1% of respondents did in 2023 compared to 38.1% in 2022. Annual accumulations reverted to 10.5% in 2023.

Table 18: Model Frequency and Business Units Differences
(In per cent of respondents)

	2023	2022	2021	2020	2019
Yes	33.3	42.9	31.6	31.6	47.4
No	57.1	57.1	68.4	68.4	52.6

Source: BMA staff calculations

With regards to the utilisation of different frequencies of accumulations, 33.3% of groups have frequency differences compared to 37.5% of legal entities.

Table 19: Internal Model Usage (In per cent of respondents)

	2023	2022	2021	2020	2019
Yes	31.6	28.6	31.6	31.6	42.1
No	68.4	71.4	68.4	68.4	57.9

Source: BMA staff calculations

The BMA also surveyed groups on the use of internal models. As of 2023, 68.4% of groups do not use internally developed models compared to the 33.3% that do.

Table 20: External Reinsurance Model Usage (In per cent of respondents)

	2023	2022	2021	2020	2019
The company has minimal Cat exposure protection, and as such, gross is effectively net	0.0	0.0	0.0	5.6	5.3
The accumulations are calculated on a gross basis with reinsurance protections calculated approximately outside of the system	0.0	0.0	0.0	0.0	5.3
The accumulations are calculated on a gross basis, with reinsurance protections calculated explicitly outside of the system	0.0	0.0	0.0	0.0	0.0
The accumulations are calculated on a gross basis with the effect of reinsurance protections calculated explicitly for some types of protection within the system	57.9	52.4	63.2	50.0	31.6
The accumulations are calculated on a gross basis with the effect of reinsurance protections calculated explicitly for each type of protection within the system	42.1	47.6	36.8	44.4	57.9

Source: BMA staff calculations

On the group level, models are used for their outward reinsurance treaties. In 2023, all groups had external reinsurance treaties to mitigate catastrophe exposure. The percentage of groups modelling reinsurance protections explicitly for all treaties within the Cat model was 42.1%.