

Climate Risk Measurement

The existing landscape and developments in Hong Kong's financial services industry **December 2022**



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Foreword

With rising temperatures and intensifying frequency of extreme weather events, climate change is exerting a significant beyond-border influence on our societies. In light of the recent 27th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP27), we are witnessing paradigm changes in global business under a new "carbon budget". There is momentum in the financial services industry to incorporate climate risk into strategic planning and risk management in the context of investor appetites and policy developments. However, market participants are continuously highlighting challenges that inhibit the industry's efforts and improvements in measuring climate risk. At this juncture, it is important to do a deep dive into financial institutions' current practices and pain points in climate risk measurement to explore how to address these challenges and facilitate further improvements in climate risk measurement, which will benefit both the financial services industry and society as a whole.

This report reviews the motivations and challenges that financial institutions globally are facing in climate risk measurement and introduces a data management framework and a model-risk management framework, which can be helpful in effectively managing the data and model risks in the climate risk measurement process. In addition, the report presents the results of a survey and interviews commissioned by the Hong Kong Institute for Monetary and Financial Research that highlight local financial institutions' practices and challenges associated with climate risk measurement. It also discusses insurers' long experience in climate risk measurement and explores its insights for other sectors of the financial services industry. The report concludes by offering considerations on the advancement of climate risk measurement in Hong Kong's financial services industry.

By illustrating market participants' practices and developments related to climate risk measurement, we hope that this report can provide financial institutions and regulators with useful insights that will help them advance efforts in climate risk measurement. This, in turn, will further consolidate and strengthen Hong Kong's position as a green and sustainable finance hub both regionally and internationally.

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Executive Summary

Climate risk is a systemic risk that has notable effects on the business and operations of financial institutions. With the degradation of climate conditions and the development of policies, technologies, and investors' demand, climate risk measurement is gaining momentum in the financial services industry. Regulators across jurisdictions and international organisations have rolled out a range of initiatives to facilitate financial institutions' climate risk measurement and management. However, there remain challenges that impede financial institutions' efforts and advances in climate risk measurement.

This report reviews the motivations and challenges that financial institutions globally are facing in climate risk measurement and introduces a data management framework and a model-risk management framework, which can be helpful in effectively managing the data and model risks in the climate risk measurement process. In addition, the report describes local financial institutions' practices and challenges in the field of climate risk measurement through a survey and interviews commissioned by the Hong Kong Institute for Monetary and Financial Research (HKIMR). It also discusses the established experience of insurers in climate risk measurement and explores its insights for other sectors of the financial services industry. The report concludes by offering considerations on the further advancement of climate risk measurement in Hong Kong's financial services industry.

The prevalent challenges in climate risk measurement facing global financial institutions involve the availability, reliability and transparency, comparability, and complexity of climate-related data, as well as the lack of standardised and consistent measurement methodologies. The lack of expertise poses additional barriers because climate risk measurement requires cross-disciplinary talent with a high degree of specialisation and expertise. Financial institutions engaged in cross-boundary and international business and operations are also challenged by the multitude of data protocols and regulatory requirements, imbalanced data availability and reliability across jurisdictions, and difficulties in assessing the cross-boundary and international spillover effects of climate risk.

A data management framework and a modelrisk management framework can be helpful in effectively managing the data and model risks in the climate risk measurement process. These frameworks are potentially applicable to all financial institutions. A data management framework enhances the usability, reliability, and quality of data assets, facilitating organisations' data-driven decisions and supporting their achievement of strategic objectives. A robust and comprehensive model-risk management framework can be helpful in identifying, managing, and controlling the potential model risks stemming from inappropriate climate-related models, technical errors, and incorrect usage.

There is positive engagement currently among Hong Kong's financial institutions in climate risk measurement. According to a survey commissioned by the HKIMR, 53% of the surveyed financial institutions have measured climate risk. The key drivers of climate risk measurement reported by the survey respondents included not only external factors such as policy developments and compliance, and industry trends and stakeholders' demand, but also internal factors such as reputation improvement, strategic imperatives, and overall risk management.

With respect to the two types of climate risk (i.e. physical and transition risks), most financial institutions consider the measurement of both to be relevant to their business and operations, with approximately 77% of the survey respondents measuring both risks. Overall, there was a stronger emphasis on transition risk than physical risk. The reasons for this shared by interviewees were not only financial institutions' role in facilitating the low-carbon transitions of their own operations and customers but also some financial institutions' limited awareness, knowledge, and resources (e.g., limited availability of physical risk data) to measure the impacts of physical risk. The major physical risk covered by the surveyed financial institutions reflects global concerns about increasing temperatures and the material physical risk that presents to Hong Kong's climate, such as tropical cyclones, extreme precipitation and flooding, and rising sea levels. The transition risk related to the developments of policies, consumer and investor preference, and technology were all important considerations for surveyed financial institutions.

Challenges remain in the field of climate risk measurement, including data availability, data quality issues (reliability and transparency, comparability, and complexity), and the lack of standardised and consistent methodologies. The availability of climate-related data and standardised measurement methodologies were the top two barriers to climate risk measurement in Hong Kong, as suggested by 68% and 59%, respectively, of the survey respondents. Some climate-related data was considered simply unavailable, and other data may suffer from limited coverage, granularity, reliability, and transparency. A lack of consistency related to measurement methodologies can lead to invalid and incomparable outputs for financial institutions. Additional challenges identified by the survey respondents engaged in cross-boundary and international activities were a lack of consistency across jurisdictions in data definition and taxonomy, data quality, and regulatory guidance and frameworks.

The industry is keen to making progress in climate risk measurement, with 76% of financial institutions planning to allocate similar or more resources over the next 12 months. Moreover, 80% of the survey respondents who were not measuring climate risk planned to measure in the future. The most widely adopted strategy for the next 12 months was to align the industry's efforts with policy developments, an approach suggested by approximately 60% of the survey participants. Resourcing also appeared to be among the top considerations, including upskilling the current workforce and leveraging third-party resources, such as the long experience of insurers in climate risk measurement.

Leveraging insurers' established experience in climate risk measurement is beneficial for other sectors of the financial services industry. Insurers' experience in the field of climate risk measurement provides insights for other sectors of the financial services industry, such as enhancing the understanding of climate risk, broadening climate risk coverage, improving data management, strengthening the application of advanced methodologies, and facilitating the good usage of measurement outputs. Taking into account the insights of market participants and the recent developments aimed at facilitating climate risk measurement both internationally and in Hong Kong, we propose some considerations that can contribute to the discussion on how to advance climate risk measurement in Hong Kong's financial services industry. Coordinated efforts between financial regulators and market participants are important. In fact, financial regulators can play a critical role in promoting a common taxonomy and mandatory climate risk disclosures, such as emissions Scope 1, 2, and 3 as defined by the Greenhouse Gas Protocol. Clear climate policies are integral to providing guidance to market participants. The public and market participants should deepen the awareness and knowledge of climate risk, which serves as the foundation of the industry's further progress in climate risk measurement. Additional considerations include strengthening local and international collaboration, and improving the availability and quality of climate-related data and methodologies. It is also important to facilitate talent development, capacity building, and knowledge sharing.

Chapter 1 Climate Risk Measurement: The International Experience

Motivations and prevalent challenges for financial institutions

HIGHLIGHTS:

- Key motivations for financial institutions to measure climate risk may include mitigating negative impacts and seizing accompanying opportunities, collaborating with regulators to achieve a low-carbon transition, meeting the expectations of stakeholders, and facilitating institutions' strategic planning and risk management.
- The prevalent challenges in climate risk measurement confronting financial institutions internationally involve the availability, reliability and transparency, comparability, and complexity of climate-related data, along with the lack of standardised and consistent measurement approaches and expertise.
- Additional challenges have been identified by financial institutions engaged in cross-boundary and international business and operations, such as the multitude of data protocols and regulatory requirements, imbalanced data availability and reliability across jurisdictions, and the need to assess the cross-boundary and international spillover effects of climate risk.

1.1. HOW IMPORTANT IS IT TO MEASURE CLIMATE RISK?

In recent decades, climate change has been accelerating, as demonstrated by rising global temperatures and intensifying natural disasters. Climate change poses widespread threats to humanity, the ecosystem, and the world economy. According to the latest research in climate science, global surface temperatures will continue to increase until at least mid-century, and many changes in the climate system, including extreme heat, heavy precipitation, and agricultural droughts, will become more severe in direct relation to increasing global warming.¹ These changes will inflict considerable economic losses if timely and effective actions are not taken.²

Climate change is a systemic risk that impacts all sectors of the economy, including the financial services industry. In addition to directly affecting financial institutions' operations, climate change can also translate into traditional financial risks and disrupt financial institutions' lending, underwriting, and investment activities. For instance, intensifying tropical cyclones can cause significant damage to coastal properties and thus increase the credit risk faced by commercial banks holding these properties as collateral. With the implementation of carbon pricing schemes, the stock prices of high-emitting firms may decline, creating a market risk for asset managers holding the securities. The results of the climate risk stress tests conducted by regulators around the world indicate that climate risk has the potential to affect the vulnerability of financial institutions and the stability of the financial system.³

Although climate change may negatively affect financial institutions' business and operations, its accompanying opportunities may be significant. The unique role of the financial services industry as the intermediary of the economy enables financial institutions to navigate, enhance, and even benefit from the transition to a low-carbon economy. For example, although achieving the target of net-zero carbon emissions requires carbon-intensive firms to change their business models, it will direct a large amount of capital to help finance sustainable projects from fund providers, such as banks and pension funds. In the meantime, insurance companies may also embrace the opportunity to provide new insurance products for sustainable projects.

In addition to the heightened risks and associated opportunities that may motivate financial institutions to address climate risk, factors such as cooperation with regulators and the expectations of stakeholders, along with strategic planning and risk management, may also play a vital role in prompting financial institutions to tackle climate risk.

Financial institutions need to cooperate with regulators seeking to achieve the objective of transitioning to a low-carbon economy. Relevant supervisory bodies have rolled out policies and initiatives to enhance climate risk management, such as requiring financial institutions to incorporate climate-related factors into their investment processes, developing climate-related risk disclosure frameworks, and conducting industry-wide climate risk stress tests. For example, in 2021, Hong Kong's Securities and Futures Commission (SFC) issued Consultation Conclusions on the Management and Disclosure of Climate-related Risks by Fund Managers, which requires fund managers to take climate-related risks into consideration in their investment and risk management processes and to make appropriate disclosures. The Hong Kong Monetary Authority (HKMA) launched its pilot climate risk stress test (CRST) in 2021, with participating banks accounting for 80% of the banking sector's total lending. The CRST aimed to assess the climate resilience of the Hong Kong banking sector as a whole and facilitate the capability building of banks for measuring climate risk. The

¹ IPCC (2021).

² For example, the Swiss Re Institute (2021) shows that compared with a world without climate change, the global GDP loss could be up to 18.1% by 2050 in a severe climate scenario of a 3.2°C rise in temperatures. The loss can be narrowed to 4.2% if the Paris Agreement's target of limiting the rise to well below 2°C is reached.

³ See, for example, BoE (2022) and ECB (2022). Please refer to AGCB and HKIMR (2022) for more details about the results of pre-2022 climate risk stress tests.

Mandatory Provident Fund Schemes Authority also issued a set of guiding principles to MPF trustees in 2021 which laid down a high level framework in integrating ESG factors into the investment and risk management processes of MPF funds and making relevant disclosures to MPF scheme members.⁴

Financial institutions need to meet the increasing expectations of stakeholders who prefer to invest in companies with a good reputation and solid performance in addressing climate risk. The evidence suggests that many investors view climate change as a significant factor in or even the centre of their investment decisions in the next two years.⁵ In addition, investors require more granular, accurate, and transparent disclosures of climate-related risks to mitigate associated problems such as greenwashing. Reputational risk increases when a financial institution is perceived to have fallen short of its stakeholders' expectations. For example, an asset management firm will suffer from reputational damage if its capital is diverted to industries and companies that rely heavily on fossil fuel despite the firm's commitment to invest in environmentally friendly projects.

Moreover, financial institutions may be motivated by strategic planning and risk management considerations. The acceleration of climate change is altering the context and priorities of financial institutions' strategic planning. The evidence confirms that financial institutions' management bodies are becoming increasingly concerned about exposure to climate-related risks.⁶ They incorporate these risks into the development of institutions' overall business strategy and objectives and exercise effective oversight of these risks. On the risk management front, although the standard risk management framework considers various traditional financial risks, the incorporation of climate risk will further improve the framework by preparing financial institutions for possible scenarios related to climate change and the associated economic transition. A survey conducted by the Australian Prudential Regulation Authority shows that most financial institutions have started to embed climate risk into elements of their risk management framework and recognise climate risk in their risk taxonomy or risk register.7

Chapter 1

Figure 1.1: Key motivations for financial institutions to address climate risk



Sources: HKIMR staff compilation.

- ⁵ Robeco (2021).
- ⁶ ECB (2021a).
- ⁷ APRA (2022).

⁴ For more detail, please refer to the following website: https://www.mpfa.org.hk/-/media/files/information-centre/legislation-and-regulations/circulars/ mpf/20211126/cir-20211126.pdf

To achieve the goals of minimising the adverse impacts of climate change and seizing the accompanying opportunities, cooperating with regulators and meeting the expectations of stakeholders, and improving strategic planning and risk management, financial institutions should take early action to manage the impacts of climate risk. If financial institutions are to develop any effective response to the impacts of climate change, they must be able to measure the scope and severity of climate-related risks in an objective and accurate manner. Therefore, climate risk measurement exhibits its significance as the first and fundamental step in the process of addressing climate risk. This report focuses on financial institutions' current climate risk measurement practices, examines the associated challenges confronting financial institutions, and highlights the potential implications of those practices and challenges for policymakers and industry players.

1.2. CHALLENGES IN CLIMATE RISK MEASUREMENT

Although measuring climate risk is critical for financial institutions to achieve the goals mentioned before numerous challenges impede them from obtaining decision-useful measurement outputs. This section explores the prevalent challenges facing financial institutions in climate risk measurement with the aim of helping financial institutions to obtain an understanding of these challenges. The discussion centres on the challenges related to the availability, reliability, comparability, and complexity of climate-related data, along with issues arising from a lack of appropriate measurement tools and methods, a lack of expertise, and engagement in cross-boundary and international activities (Figure 1.2).



Figure 1.2: Major challenges in climate risk measurement for global financial institutions

Source: HKIMR staff compilation.

1.2.1. Availability of climate-related data

As highlighted in numerous studies,⁸ the lack of available data is one of the most fundamental challenges in measuring climate risk (Figure 1.3). In addition, there is an improving and evolving understanding of the science of climate risk and its impacts on financial institutions. In the absence of climate-related data and suitable methodologies, the measurement of climate risk may depend mostly on subjective beliefs, which limits the usability of the resulting outputs.

One availability issue results from limited data coverage, as some data are either unavailable or only partially available for certain geographical locations, economic sectors, enterprise populations, or asset classes. For instance, there are limited climate-related data for emerging markets and developing countries, small and medium-sized enterprises, and securities traded on over-the-counter markets.⁹

Another availability issue arises from the insufficient level of disaggregation of climate-related data.¹⁰ For example, it is challenging to obtain relevant data that measure the physical risk carried by a facility in a specific location or the transition risk for projects with underlying dependencies on financial institutions.

The third availability issue is associated with the lack of forward-looking data, such as the data describing firms' projected carbon emissions pathways, their vulnerability and resilience to certain types of climate risks, and their adaptation and mitigation measures to address future climate risks.¹¹ Moreover, it is difficult to use existing data to forecast the evolution of policies, technologies, and consumer preferences and to gauge their effects on the financial services industry.¹²





⁸ See, for example, FSB (2021), IMF (2021), and NGFS (2021, 2022).

- ⁹ BoE (2022), DNB (2022), ESRB (2021), IMF (2021), and NGFS (2021, 2022).
- ¹⁰ FRB (2021) and NGFS (2021, 2022).
- ¹¹ ESRB (2021), IMF (2021, 2022), and NGFS (2021, 2022).
- ¹² ECB (2022) and IMF (2021).

Low accessibility to potential data sources is another challenge.¹³ Because of the lack of centralised data repositories, financial institutions may spend a substantial amount of effort locating the sources of desirable data. Although data from public sources are free of charge, they may not be stored in machine-readable formats. Data from private sources are usually more structured and granular, but their high cost may be a burden for many financial institutions.¹⁴

Because of the lack of centralised data repositories, financial institutions may spend a substantial amount of efforts locating the sources of desirable climate-related data. Additional issues may be associated with the availability of specific data items. As a typical example, there is a shortage of data on value chain emissions, avoided emissions, and financed emissions, all of which are essential to a complete understanding of the climate risk facing financial institutions' counterparties.¹⁵ Furthermore, there are limited data with which to assess how climate risk is transferred or amplified through the interlinkages of financial institutions, via financial securities transactions, and through the feedback mechanism between the financial system and the real economy.¹⁶

1.2.2. Reliability of climate-related data

The unreliability of climate-related data presents another major challenge in measuring climate risk (Figure 1.4). Unreliable climate-related data can lead to incomplete, misleading, or incorrect measurement

Figure 1.4: Major barriers to data reliability



¹³ DNB (2021) and NGFS (2021, 2022).

- ¹⁵ BoE (2022), ESRB (2020), and NGFS (2022).
- ¹⁶ FSB (2021).

¹⁴ FRB (2021).

outputs, thereby reducing the usefulness and robustness of these outputs in supporting financial institutions to address climate risk.

One major reliability issue arises from the reliance on historical information.¹⁷ Given the distinct characteristics of climate risk, such as its non-linearity,¹⁸ heterogeneity,¹⁹ and high uncertainty, physical risk indicators relying on historical information may fall short of capturing the risks that can be expected as a result of climate change, raising the need to integrate forward-looking information.²⁰

Due to the lack of mandatory and homogeneous climate-risk disclosure requirements, the data reported by private firms may be partial, unaudited, or missing.²¹ This is exacerbated by the underdevelopment of, and lack of requirement for, data verification or assurance process. This issue also opens the door for greenwashing, which arises from insufficient accreditation of firms' sustainable activities.

Another related reliability issue results from conflicting data definitions.²² For instance, green taxonomies that determine whether a firm's activities facilitate the transition to a low-carbon economy are not entirely consistent across different regions and industries, which limits the power of the corresponding green/ brown share indicators in reflecting the level of transition risk to which a firm is exposed.

The lack of transparency in the construction of climate-related data is also a distinguishing reliability concern, especially for data disclosed by private firms or supplied by private data vendors, such as environmental, social, and governance (ESG) rating agencies.²³ This issue is particularly troublesome when no or only limited information about how data are collected, transformed, and estimated is disclosed, making it difficult for financial institutions to understand what the data really measure. For example, the problems caused by applying inconsistent principles, criteria, and methods when constructing ESG scores have received considerable attention and have been extensively investigated in a number of studies.²⁴

The lack of transparency in the construction of climate-related data is a distinguishing reliability concern, especially for data disclosed by private firms or supplied by private data vendors.

The ambiguous interpretation of some climaterelated data items also undermines their reliability. For instance, it is customary in academic studies²⁵ to use the carbon emission indicator as a proxy of transition risk. However, that indicator may only reveal firms' historical reliance on fossil fuel resources and not their plans to cut carbon emissions because of the prospect of more stringent climate regulations.²⁶

- ²⁴ See, for example, EC (2021a) and IOSCO (2021).
- ²⁵ See, for example, Bolton and Kacperczyk (2021), Hsu et al. (2020), and Alessi et al. (2021).
- ²⁶ AGCB-HKIMR (2022) and DNB (2022).

¹⁷ FRB (2021).

¹⁸ Small and incremental developments in climate may lead to large and abrupt changes in the ecological system, which may subsequently cause serious and unexpected damage to the economy.

¹⁹ The effect of climate risk varies across locations and industries and should be understood within its geographic and economic context.

²⁰ ESRB (2021).

²¹ BoE (2022), ESRB (2020), and NGFS (2021, 2022).

²² IMF (2021).

²³ BdF (2022) and NGFS (2021).





Source: HKIMR staff compilation.

1.2.3. Comparability of climate-related data

The lack of comparability is also a significant challenge encountered by financial institutions when measuring climate risk (Figure 1.5). If sets of climate-related data cannot be compared, the measurement outputs may not be comparable either and thus will be less useful for decision-making.

One challenge arises out of the difficulty in determining the degree of greenness of a company based on different metrics. For example, although both carbon emission indicators and green/brown share indicators measure the transition risk, it is not straightforward to tell whether a firm emitting a larger amount of greenhouse gases or a firm producing a lower share of eco-friendly products has greater exposure to transition risk. Data with similar concepts also may not be comparable if they are constructed using different methods or are obtained from disparate sources.²⁷ This issue is more serious if the original data sources contain little information about their coverage, timing, underlying assumptions, and estimation methods.²⁸ For example, the climate risk stress test conducted by the ECB²⁹ reveals that the use of varying proxy techniques and data providers in estimating Scope 3 carbon emissions leads to a high level of disparity in the reported results.³⁰ The lack of a standardised climate-related data disclosure framework also prevents direct comparisons of financial reports prepared under different disclosure frameworks.³¹

³¹ BdF (2022).

²⁷ FRB (2021).

²⁸ NGFS (2021).

²⁹ ECB (2022).

³⁰ The definitions of the three scopes of carbon emissions can be found in GGP (2004).

Comparability issues may also originate from the lack of common definitions, technical standards, or unique identifiers for companies and financial assets.³² The last issue creates significant barriers in linking climaterelated data to financial data, thus obstructing the process of evaluating the impacts of climate risk on financial institutions' business.

The fact that climate policies differ across industries and geographies increases the difficulty of comparing climate data retrieved from different sources. It should be emphasised that even when climate-related data are comparable, the lack of a relevant benchmark renders the comparison less meaningful.³³

1.2.4. Complexity of climate-related data

The complexity of climate-related data also creates obstacles to measuring climate risk (Figure 1.6). It increases the cost of correctly understanding and utilising climate-related data while reducing the interpretability of the measurement outputs.

One important complexity issue stems from the fact that some climate-related data may not be

representative in capturing the nature of climate risk. For example, given the nonlinearity and high uncertainty of climate risk, using the average historical losses caused by extreme weather events may underestimate their potential to cause future damage.

Data complexity issues also emerge from the difficulty of integrating data from scattered sources or in different formats.³⁴ For example, to gain a holistic view of how climate risk affects a financial institution's business and operations, it may be necessary to collect both numerical and geographical data from public and private data sources and to conduct an extensive procedure of validating, cleaning, standardising, and merging the data.

Another problem results from the complexity embedded in the rules and methods that govern the collection and estimation procedures of different data.³⁵ For instance, prior knowledge of the geographic information system is fundamental to comprehending the patterns and relationships inherent in geographical data, which itself is essential to correctly and efficiently utilising geographical data to measure climate risk.



Source: HKIMR staff compilation.

- ³³ NGFS (2022).
- ³⁴ FRB (2021) and NGFS (2021).
- ³⁵ NGFS (2021).

³² BIS (2021) and NGFS (2021, 2022).

1.2.5. Lack of standardised and consistent methods and tools

Challenges related to climate risk measurement may further arise from the difficulty in choosing the appropriate measurement methods and tools (Figure 1.7).

Although public and private organisations offer a variety of methods and tools for measuring climate risk, there is no criteria to guide financial institutions to select the one that yields the most accurate and robust measurement outputs.³⁶ One observation of the climate risk stress test created by the Bank of England is that more sophisticated approaches require more intensive data inputs and calibration efforts,³⁷ which suggests that the collection of data and choice of methods are not independent but rather require a trade-off to be made between them.

Another challenge is the issue of how to generalise measurement methods and tools that are only applied in specific regions or industries. For example, the insurance sector has a long history of using natural catastrophe models to assess the impacts of natural disasters on the underwriting business, leaving open the guestion of how such methods can be adapted and broadly used by banks and asset managers to measure the impacts of acute physical risk.

Although there are a variety of available methods and tools for measuring climate risk, there is no criteria to quide financial institutions to select the one that yields the most accurate and robust measurement outputs.

Issues may also arise from the difficulty of measuring the impacts of climate risk within the traditional financial risk modelling framework.³⁸ For example, it is unclear how and to what extent climate-related risks affect the risk weights, probabilities of default, or other parameters in credit risk modelling. Furthermore, the portfolio invariance assumption in credit risk models is at odds with the uneven impacts of climate risk on different economic sectors and geographical locations and may need to be changed.

Like the challenges regarding climate-related data, financial institutions may encounter issues related to the availability, reliability, comparability, and complexity of methods and tools. For example, certain measurement objectives of financial institutions, such as quantifying the impacts of



Figure 1.7: Challenges associated with the lack of standardised and consistent methods and tools

- ³⁶ NGFS (2021).
- ³⁷ BoE (2022).
- ³⁸ ECB (2021b).

climate risk over decades or measuring firms' mitigation efforts in tackling climate risk,³⁹ may not be achievable using existing methods and tools.

1.2.6. Lack of expertise

The lack of expertise poses additional layers of difficulty to climate risk measurement. Collecting, processing, and analysing climate-related data may necessitate a high degree of specialisation and a considerable amount of capacity, which are beyond the reach of many financial institutions, especially small and medium-sized institutions.⁴⁰ In addition, the shortage of experienced and cross-disciplinary talent in climate risk measurement, along with the modest supply of tertiary education programs and professional qualifications, hinder financial institutions from accessing a qualified workforce that can measure climate risk.

1.2.7. Challenges related to cross-boundary and international business

In addition to the major challenges mentioned above, financial institutions that engage in cross-boundary and international businesses may face additional challenges in climate risk measurement. For example, the multitude of data protocols and regulatory requirements across jurisdictions increases the difficulty for financial institutions to compare and combine the data collected from different geographical areas.⁴¹ Moreover, the availability and reliability of data and skewed towards more advanced economies, which may create an imbalance for financial institutions operating in both developed and developing economies. Furthermore, it remains unclear how to measure the cross-boundary and

international spillover effects of climate risk through trading activities and financial transactions, yet this information is essential for gaining a clear picture of climate risk.

The availability and reliability of data are skewed towards more advanced economies, which may create an imbalance for financial institutions operating in both developed and developing economies.

The prevalence and materiality of the challenges outlined above prevent financial institutions from achieving their various goals through the measurement of climate risk. As emphasised in many reports,⁴² it is essential for financial regulators to develop decision-useful climate risk metrics, implement standardised climate risk disclosure frameworks, and promote globally consistent climate finance taxonomies. From the standpoint of financial institutions, a good industry practice would be to adopt a high-level climate risk measurement architecture that encompasses a data management framework aiming to improve the quality of data, along with a model-risk management framework that aims to reduce the risks embedded in its tools or methods. As discussed in the next chapter, this architecture will help financial institutions to better address the above challenges in a more consistent and effective manner.

³⁹ ECB (2022) and FRB (2021).

⁴⁰ BIS (2021), ESRB (2021), FRB (2021), IMF (2021), and NGFS (2021, 2022).

⁴¹ IMF (2021).

⁴² For example, AGCB-HKIMR (2022), EC (2021b), IMF (2021, 2022), and NGFS (2021, 2022).

Chapter 2 Data and Model-risk Management

A framework for climate risk measurement

HIGHLIGHTS:

- Data and model-risk management within financial institutions can be helpful in facilitating climate risk measurement, which is composed of inputs, analysis, and output and usage.
- A data management framework enhances the usability, reliability, and quality of data assets, facilitating organisations' data-driven decisions and supporting their achievement of strategic objectives.
- A robust and comprehensive model-risk framework is helpful in identifying, managing, and controlling the potential risks stemming from inappropriate climate-related models, technical errors, and incorrect model usage.



Figure 2.1: Data and model-risk management in the climate risk measurement process

Source: HKIMR staff compilation.

Financial institutions are facing various challenges in climate risk measurement, which mainly focuses on climate-related data and methodologies. Regulators, international organisations, and industry associations have rolled out a broad range of initiatives to address these challenges, repeatedly emphasising the management of data and model-risks throughout the procedures of inputs, analysis, and output and usage.43 Data and model-risks management within financial institutions can be helpful in facilitating climate risk measurement, which is composed of inputs, analysis, and output and usage. Inputs, including climate-related data and qualitative information from various sources, are fed into different climate-related models, such as stress testing and sensitivity analysis, for analysis and processing. Estimation outputs generated from the models are subject to verification and validation and can be used for making decisions and formulating

strategies (Figure 2.1). Below, we separately introduce a high-level data management framework and a model-risk management framework that financial institutions can use to manage the climaterelated data and model-risks.

2.1. DATA MANAGEMENT FRAMEWORK

Climate-related data serve as the foundation for financial institutions to gain business intelligence in climate risk measurement. A data management framework is a framework that treats these data as a strategic asset and aims to extract their maximum value. It enhances the usability, reliability, and quality of the data assets, facilitating an organisation's datadriven decisions and supporting its achievement of strategic objectives.

⁴³ For instance, HKMA (2021a) emphasises that financial institutions should be aware of the possible model risks. MAS (2020) advises businesses to take appropriate measures to guarantee the accuracy of their data and to perform independent reviews with the help of internal control and audit units.

Insufficient data management can generate lowquality outputs and distort business decisions in addressing climate risk, exposing financial institutions to various types of business and operational risks. First, poor data management generally requires staff to spend a considerable amount of time validating and fixing data errors, and the final output is typically of low guality and limited reliability. Financial institutions relying on these data and outputs can make biased and incorrect estimations of climate risk's impacts on their business, causing additional financial losses and missed business opportunities. Second, the maintenance of good data management and guality can mean the difference between compliance and millions of dollars in fines. Compliance is an ongoing issue as governments and regulators around the world are putting more effort into and emphasis on climate risk disclosures and management. Third, customers and investors may also lose confidence and trust in financial institutions that disclose lowguality climate-related data and information, which adversely influence those institutions' long-term development.

A data management framework enhances the usability, reliability, and quality of the data assets, facilitating an organisations' data-driven decisions and supporting their achievement of strategic objectives.

A data management framework plays a pivotal role in eliminating or mitigating the potential risks arising from the insufficient data management mentioned above. The data management framework includes four key elements: (1) data governance, (2) data life cycle management, (3) metadata management, and (4) data quality management (Figure 2.2).⁴⁴

Data governance

Data governance is the exercise of authority and control, including planning, monitoring, and enforcement, over the management of data assets. Data governance is an overarching function that guides all other data management functions and is implemented within the context of a broad business and data management strategy. It emphasises the rules, people's roles, processes, and technologies that work together to align everyone in the organisation to ensure the proper usage of data. A data governance function enables an organisation to be data-driven by implementing the strategy and supporting the principles, policies, and stewardship practices that ensure that the organisation recognises and acts on opportunities to obtain value from its data. A data governance committee may be established as a forum to escalate data issues and maintain oversight of all data-related activities.

Data life cycle management

All data have a life cycle – from initial collection, storage, usage, and archival to final deletion. Data life cycle management specifies the rules, processes, and procedures of managing data throughout their life and ensures that an organisation implements the right policies at each stage of the data life cycle. Data life cycle management involves planning and designing for reliable and high-quality data, establishing processes through which data can be enabled for use and then maintained, and using the data for various analyses to enhance their value.

Climate-related data are associated with diverse challenges, namely, availability and quality issues (reliability and transparency, comparability, and complexity), making it necessary to establish a

⁴⁴ Our data management framework references the framework in DAMA (2017), which is one of the commonly referred data management frameworks. Our framework is further revised to better suit the context of climate-related data management.



Figure 2.2: Data management framework

Source: DAMA (2017) and HKIMR staff compilation.

programme of data life cycle management that facilitates data creation, integration and interoperability, usage and documentation, and data warehousing. For instance, financial institutions may formulate plans to enhance the data collection process by strengthening their engagement with clients to develop a better understanding of the impacts of climate-related risks on the clients' business and obtaining an increased amount of climate-related or environmental information from the clients.⁴⁵

Metadata management

Metadata are data about data. Metadata help an organisation understand the information underlying data, including information about the content and context of data (e.g., the title and creator), physical structure (e.g., the file format), and information used to manage data (e.g., the method and time they were created). Metadata management involves establishing policies and processes that ensure that data can be accessed, integrated, analysed, and maintained effectively across the organisation.

Because data play an increasingly pivotal role in financial institutions' business decision-making processes, metadata management is integral to enhancing the consistency and trustworthiness of the data and improving the efficiency of business operations. For instance, because climate-related data are usually multi-sourced and may have different formats or degrees of granularity, metadata management enables organisations to learn about the data's context to use them appropriately and assess their availability, guality, and usability. Financial institutions are advised to define a metadata strategy that is clearly defined and aligned with the business's goals and vision, adopt metadata standards to ensure the proper use of data, and select appropriate metadata tools based on business goals and the technology infrastructure.

45 HKMA (2021a).

Data quality management

Data quality management can be defined as a set of practices undertaken by a data manager or a data organisation to maintain high-quality information to assure that it is fit for consumption and meets the needs of data consumers. Robust and efficient data quality management encompasses several key elements, including developing and establishing data quality and compliance policies and standards, identifying and coordinating the involvement and efforts of relevant staff, reporting and sharing data quality assessment results with relevant staff, and identifying opportunities to improve data quality.

Financial institutions that rely on low-quality climaterelated data may not only incorrectly assess their exposure to climate risk, leading to biased and incomplete business decisions, but also damage their reputation and lose revenue and customers. Certain dimensions can be utilised to assess data quality. Although there is not a one-size-fits-all set of data quality dimensions, the options have some commonalities. Dimensions focus on whether there are enough data (completeness), whether they are correct (accuracy, validity), how well they fit together (consistency, integrity, uniqueness), and whether they are up to date (timeliness), accessible, usable, and secure.⁴⁶ Because it is not uncommon for financial institutions to source some climate-related data from external consultants or vendors, they should have an appropriate process to assess the quality and reliability of data products or services. For instance, they may seek to understand data coverage, data sources, key assumptions, and limitations.⁴⁷

2.2. MODEL-RISK MANAGEMENT FRAMEWORK

The data governance framework specifies the principles and procedures that financial institutions can follow in dealing with climate-related data to

enhance the quality of the data and extract their maximum value. In addition to climate-related data. models are another key element in producing desirable outputs for financial institutions' decision making related to climate risk. A framework that provides guidance for model usage and alleviates relevant risks is integral to financial institutions' overall risk management. The commonly used methods in climate risk measurement include climate risk indicators and scenario-based methods, the latter of which encompass stress testing and sensitivity analysis.48 Regardless of the complexity level of the models, financial institutions may be subject to model risks, which refer to the risk of errors in the process of developing, implementing, or using climate risk models

A robust and comprehensive model-risk framework is helpful in identifying, managing, and controlling the potential risks stemming from inappropriate climate-related models, technical errors, and incorrect model usage.

The sources of model risks may stem from inappropriate climate-related models, technical errors, and incorrect model usage. First, financial institutions may use incorrect models that make unrealistic or unwarranted assumptions about climate risk or omit climate risk factors that are important to their business and operations, such as the linkage of rising temperatures and physical climate events, the interaction and feedback loop between climate change and corresponding policies, and the actual influence of climate change on various economic sectors. Second, technical errors may result from poor management and control of climate-related data collection, input, model design,

⁴⁶ DAMA (2017).

⁴⁷ HKMA (2021a).

⁴⁸ A detailed description of these methods can be found in AGCB-HKIMR (2022)

implementation, and validation. Such errors can also be caused by staff members lacking the necessary competence to rigorously and promptly monitor climate risk models, especially given that climaterelated work usually requires multi-disciplinary background and knowledge. Third, incorrect model usage may come from management's limited knowledge of climate risk and inappropriate decisions due to their failure to fully understand the model results. The outputs of non-comparable climate risk models may be compared, leading to meaningless conclusions.⁴⁹

A robust and comprehensible framework will be helpful in identifying, managing, and controlling the potential model risks described above. The main blocks of such a model-risk management framework include (1) organisation and governance, (2) model standards, (3) model validation and monitoring, and (4) the model-risk management culture (Figure 2.3).⁵⁰

Organisation and governance

Effective oversight of climate risk models by the board and senior management provides assurance that model risks are evaluated at a sufficiently senior level and provides a foundation for internal controls. Firms can establish a model inventory as a centralised model governance system to manage the various models in use, including climate risk models. Inventory is used to identify, track, and document model usage and to regularly review models.

To reduce model risks resulting from an opaque process of model design and development, unclear lines of authority and responsibility, or an absence of thorough documentation and instructions for handover procedures, firms are advised to provide a clear explanation of the roles and duties of model developers, owners, reviewers, and internal auditors, along with policies and guidelines covering all of the procedures and components of model-risk management.⁵¹





Source: Deloitte (2020), KPMG (2019) and HKIMR staff compilation.

- ⁵⁰ Deloitte (2020), KPMG (2019).
- ⁵¹ KPMG (2016).

⁴⁹ Deloitte (2020).

Model standards

Establishing standards for the full workflow of a climate risk model – from definition, development, commissioning, review, validation, and approval to application, realignment, and documentation – helps ensure transparency and rule-based rigor throughout the model's life cycle. These standards enable companies to fully meet compliance requirements or to leverage industry best practices. Detailed standards and documentation also allow internal and external experts to independently validate models. A standardised model output report can clearly display the model's inputs, assumptions, and outputs and can explain the model's limitations so that senior management can make informed decisions.

Model validation and monitoring

Because of the immaturity of climate risk models, which lack historical data and standards for model validation, financial institutions may choose to use statistical model setups that are inappropriate for the complex interrelationships between factors and result in anomalous model results.⁵² Climate-related models placing an undue emphasis on historical data and insufficiently accounting for forward-looking information may lead financial institutions to underestimate the impacts of climate risk, particularly transition risk.⁵³ For financial institutions relying on climate risk models provided by third parties, mismatches and non-applicability of the black-box models to their business models also pose risks. Because of the lack of standards in model usage, the relevant assumptions, and the data inputs in the industry, the outputs across sectors, firms, and even within the same firm are occasionally noncomparable.

An independent and competent team using a customised approach to testing and validating

models before they are put into use can identify model errors in a timely manner. For climate risk models that are still in their infancy, the basic setup of the model can be reviewed, the reasonableness of the climate scenarios can be assessed, and the reliability and comparability of the results across scenarios and analytical methods can be checked. The process and output of the model also need to be monitored on an ongoing basis so that the company can respond quickly and appropriately to address the issues and deficiencies identified in the model.

Model-risk management culture

The defence structure, consisting of the model's owner, independent compliance, and the internal auditor, provides a systematic approach to model-risk management through a clear hierarchy of tasks. In addition to the general monitoring described above, the involvement of the internal auditor can further improve the quality of model-risk monitoring and ensure that related activities are compliant and functionally effective. Good communication and collaboration between the three lines of defence can promote greater understanding of model use and its impacts, eliminate potential conflicts of interest or incompatible responsibilities, transform the governance mindset, and embed model-risk management into the organisation's culture.

Although a model-risk management framework does not necessarily mean that financial institutions can be immune from all of the risks embedded in models, it is useful to decrease the risk of errors in the process of developing, implementing, and using climate risk models. In addition, the framework can help financial institutions more accurately evaluate their exposure to climate risk and to make business decisions that adapt their strategy to various environmental conditions.

⁵² HKMA (2021b).

⁵³ MAS (2022).

Chapter 3 Climate Risk Measurement in Hong Kong's Financial Services Industry

Market views on status quo, challenges, and future plans

HIGHLIGHTS:

- The key drivers of surveyed financial institutions' climate risk measurement comprised policy developments and compliance, industry trends and stakeholders' demand, reputation improvement, strategic imperatives, and overall risk management.
- Most financial institutions considered the measurement of both physical and transition risks to be relevant to their business and operations, with approximately 77% of the survey respondents measuring both risks.
- Challenges remain in climate risk measurement, including the availability of climate-related data, data quality issues (reliability and transparency, comparability, and complexity), and the lack of standardised and consistent measurement methodologies.
- 76% of the survey respondents have planned to allocate similar or more resources to climate risk measurement in the next 12 months compared with the last 12 months, signalling the industry's interest in making progress.

Market participants' insights are integral to learning about the financial services industry's experience and pain points in the area of climate risk measurement. To collect relevant information from local market participants, the HKIMR commissioned a survey entitled Climate risk measurement: Existing experience and data issues in Hong Kong's financial services industry (hereinafter, the Climate Risk Measurement Survey) from July to August 2022. Survey questionnaires were sent to market participants across financial sectors in Hong Kong, including banks, insurers, and asset managers, and some of the participants were also involved in provision of pension-related services. In addition, some banks, insurers, and asset managers were invited to attend interviews to share their in-depth insights on this topic. The following sections of this chapter present the key findings of the survey and interviews.

3.1. DRIVERS OF FINANCIAL INSTITUTIONS' CLIMATE RISK MEASUREMENT

The survey results show that more than half of the surveyed financial institutions have measured climate risk (53%). The key drivers reported by these financial institutions comprised policy developments and compliance, along with industry trends and

stakeholders' demand (Figure 3.1). Other important considerations included reputation improvement, strategic imperatives, and overall risk management. The interviewees' responses echo these survey results.

Policy developments and compliance goals were cited as the top drivers of climate risk measurement, with 88% of the surveyed financial institutions aiming to align their practices with policy developments and 70% seeking to comply with requirements involving climate-related disclosures. Financial regulators in Hong Kong have issued guidelines on climate risk management.54, 55, 56 In November 2021, the Stock Exchange of Hong Kong Limited (HKEX) published its Guidance on Climate Disclosures to facilitate TCFD-aligned⁵⁷ reporting. Furthermore, the Green and Sustainable Finance Cross-Agency Steering Group (CASG)⁵⁸ announced plans to impose mandatory TCFD-aligned climaterelated disclosures by 2025. The SFC and the HKEX are evaluating a climate-first approach to implement the ISSB standards for Hong Kong listed companies.⁵⁹

Following industry trends and meeting stakeholders' demand were additional drivers of climate risk measurement, suggested by 73% and 64%, respectively, of the survey respondents. International clients – especially clients from jurisdictions where

⁵⁴ In December 2021, the HKMA announced its supervisory expectations for authorised institutions to incorporate climate risk considerations into their strategies and frameworks in Supervisory Policy Manual Module GS-1, titled 'Climate Risk Management'. The HKMA also issued a circular to provide the industry with information about sound practices that support the transition to carbon neutrality, and it completed a pilot climate risk stress test exercise to assess the climate resilience of the banking sector.

⁵⁵ In August 2021, the SFC issued its Consultation Conclusions on the Management and Disclosure of Climate-related Risks by Fund Managers and amended its Fund Manager Code of Conduct (FMCC) to require fund managers managing collective investment schemes to consider climate-related risks in their investment and risk management processes and to make appropriate disclosures.

⁵⁶ In November 2021, the MPFA issued the Principles for Adopting Sustainable Investing in the Investment and Risk Management Processes of MPF Funds which laid down a high level framework to MPF trustees in integrating ESG factors into the investment and risk management processes of MPF funds and making relevant disclosures to MPF scheme members.

⁵⁷ TCFD refers to the Task Force on Climate-Related Financial Disclosures, which was created by the Financial Stability Board (FSB) in 2015. In 2017, the TCFD released climate-related financial disclosure recommendations designed to help companies provide better information to support informed capital allocation.

⁵⁸ The CASG was co-created by the HKMA and the SFC together with other public organisations, including the Insurance Authority and the MPFA. The CASG aims to co-ordinate the management of climate and environmental risks in the financial sector, accelerate the growth of green and sustainable finance in Hong Kong, and support the government's climate strategies.

⁵⁹ For more detail, please refer to the website here: https://www.info.gov.hk/gia/general/202206/21/P2022062100307p.htm.



Figure 3.1: Climate risk measurement: Key drivers

Source: HKIMR staff calculations based on the Climate Risk Measurement Survey.

sustainability is an established concept – were cited as demanding more sustainable investment strategies and products. Increasing demand of investors and customers means that banks, insurers, and asset managers need to incorporate their capabilities of addressing climate risk as part of their product and service offerings to remain competitive, meet customer needs, and capture the growth opportunities provided by emerging trends.

Building on investor and customer sentiments, many survey respondents deemed that measuring climate risk could improve the institution's reputation and facilitate its strategic planning. ESG is the core of many institutions' strategic goals, including net zero commitments and transition plans. The transparent communication and measurable execution of an institution's climate risk strategy is now key for financial institutions that wish to maintain a good reputation in the competitive market. Several interviewees were proactively striving to become industry leaders through their ESG strategies. More than 40% of the surveyed financial institutions viewed climate risk as a material risk that needs to be incorporated into the overall risk management framework. Although different institutions may have adopted varying approaches – from treating climate risk as an independent risk type to treating it as a transverse risk across the organisation, most of the surveyed financial institutions were embedding climate risk into their current risk taxonomies, risk management frameworks, and enterprise management systems.

The key drivers of financial institutions' climate risk measurement included policy developments and compliance, industry trends and stakeholders' demand, reputation improvement, strategic imperatives, and risk management.

A growing number of financial institutions have realised the adverse impacts of climate risk on their financial risks. The survey results show that most of the respondents deemed operational risk, credit risk, and market risk to be influenced by climate risk, with varying degrees of impacts from physical risk and transition risk (Figure 3.2).60 A majority of the respondents (73%) agreed that physical risk has strong impacts on operational risk, likely because of its impacts on physical assets and business continuity. Transition risk were considered exerting considerable impacts on market risk and credit risk, as suggested by 76% and 66%, respectively, of the respondents, likely because market sentiments and capital allocation are expected to shift with the transition to a low-carbon economy. With the broad impacts of climate risk becoming clearer to the market, some survey respondents saw climate change as a source of both risks and opportunities for their businesses. According to several of the interviewees, more research needs to be done to provide them with a better understanding of the impacts of climate risk on their business and operations.

Figure 3.2: Financial risks most affected by climate risk: Views of survey respondents



Source: HKIMR staff calculations based on the Climate Risk Measurement Survey.

3.2. THE MEASUREMENT OF PHYSICAL AND TRANSITION RISKS AMONG FINANCIAL INSTITUTIONS

Regarding the focus on physical and transition risks, approximately 77% of the surveyed financial institutions measured both physical and transition risks, about 20% measured transition risk only, and more than 3% measured physical risk only (Figure 3.3). This indicates that a majority of financial institutions considered the measurement of both physical risk and transition risk to be relevant to their business and operations and were implementing strategies to measure the associated impacts of both risks.

Some financial institutions have limited awareness about rarely occurred events, and insufficient knowledge and resources with which to measure the impacts of physical risk on their business and operations.

Overall, there was a stronger emphasis on transition risk than physical risk. The interviewees expressed two likely reasons for this. First, financial institutions may not only pledge to meet net zero commitments in their operations but may also help their clients in achieving low-carbon transitions through their role in financed emissions.⁶¹ Accordingly, it is crucial for them to understand the impacts of transition risk on the portfolios. For example, banks need to understand their customers' transition plans so that they can provide appropriate support (e.g., financing

⁶⁰ The channels through which physical risk and transition risk exert influence on financial risks may be different. To give a concrete example, impacts of physical risk on operational risk (e.g., severe weather events disrupting an institution's operability); on credit risk (e.g., devaluation of properties leading to increased default probabilities); on market risk (e.g., higher stock market volatility due to intensifying physical hazards). Impacts of transition risk on operational risk (e.g., increased cost of utilising renewable resources); on credit risk (e.g., high default probability for carbon-intensive firms); on market risk (e.g., changes in climate policy leading to abrupt repricing of financial assets).

⁶¹ Financed emissions are emissions generated as a result of financial services, investments, and lending by the investors and companies that provide financial services.

sustainable projects through green loans). For asset managers, a good knowledge of how transition risk can impact their investment portfolios may influence their engagement strategy with stakeholders so that they can align that strategy with the stakeholders' net zero ambitions. Second, some financial institutions have limited awareness about rarely occurred events,⁶² and insufficient knowledge and resources (e.g., limited physical risk data) with which to measure the impacts of physical risk on their business and operations.

Figure 3.3: The measurement of the two types of climate risk among financial institutions



Source: HKIMR staff calculations based on the Climate Risk Measurement Survey.

Notably, physical risk was a focus of general insurance underwriting and real estate investment firms, as stated by several interviewees. For general insurers, measuring physical risk is integral to their underwriting business, along with the coverage and premium they can offer to policyholders, which impacts their liabilities. From the perspective of investment firms, physical risk can adversely impact the value of their real estate portfolios. Some insurers stated that more research is needed to better understand the relationship between physical risk and human health, which may imply that in the future, life and health insurers will increase their emphasis on physical risk.

The top four physical risk measured by the survey respondents across the three sectors were consistent, including global concerned increasing temperatures, and the material physical risk related to Hong Kong's climate - tropical cyclones, extreme precipitation and flooding, and rising sea levels (Figure 3.4). It's worth noting that the risk of tropical cyclones was covered by 100% of the surveyed insurers that measured physical risk. This is consistent with the interviewees' view that tropical cyclones are a key physical risk in Hong Kong, especially for property and casualty (P&C) insurers, given their significant impacts on commercial properties and the economy. The transition risk related to policy developments, consumer and investor preference changes, and technology developments were all cited as important considerations by a great majority of the surveyed financial institutions across the three sectors.

The survey also asked financial institutions about the impacts of climate risk on their pension-related services, given that the investment horizon of MPF funds stretches over several decades, making them vulnerable to long-term investment risks. Climate risk is among those evolving long-term investment risks that should be taken into account in the investment and risk management processes. The survey results show that 65% of the respondents either took climate risk into account to some extent or planned to take it into account when providing pension-related services, and the rest did not yet have a plan or believed that it was too soon to arrive at a conclusion. These responses indicate that although there is overall good appetite for climate risk measurement within the industry, there is still room for greater engagement among market participants.

⁶² This phenomenon may be related to agents' rational inattention to rare events, as proposed by Maćkowiak and Wiederholt (2018).

Of the pension services providers, 45% indicated that it was too soon to decide whether physical or transition risk would have a larger impacts on their businesses, indicating that more research and guidance may be required. Another 40% of the respondents⁶³ expected transition risk to exert a larger or similar impacts, which is aligned with the fact that transition risk is covered by more market participants because of their role in financed emissions. Some interviewees stated that physical risk was not yet a short-term risk to consider in their business and operations.

3.3. DATA AND METHODS ADOPTED IN CLIMATE RISK MEASUREMENT

Data and methods comprise the basic elements that financial institutions utilise to produce outputs of climate risk measurement, such as their exposure to specific types of climate risk. On the data side, the surveyed financial institutions commonly used thirdparty providers (private and/or public data providers), internal proprietary data, and public disclosures by companies, with each being selected by more than half of the respondents (Figure 3.4). Because no data source provides a complete coverage of climaterelated data, 79% of the surveyed financial institutions relied on more than one data source. Banks deviated from insurers and asset managers in utilising more information collected from clients, as suggested by 50% of the banks. Based on the interviews, some banks collected client data as part of their onboarding and risk assessment process and to facilitate their support for their clients' efforts to achieve net zero transition.

On the methodology side, climate risk indicators were widely used by the surveyed financial institutions to measure both physical risk and transition risk. Figure 3.5 shows the top three indicators adopted by the survey respondents to measure physical and transition risks respectively. The most widely used physical risk indicators include attributes of physical assets (e.g., location and age of assets), damage and losses induced by physical hazards, and characteristics of climate and weather events (e.g., frequency and severity of natural disasters).



Figure 3.4: Data sources used to measure climate risk

Source: HKIMR staff calculations based on the Climate Risk Measurement Survey.

⁶³ This includes 33% of banks, 75% of insurers, and 30% of asset managers that responded to this question.

Chapter 3



Figure 3.5: Common indicators to measure physical and transition risks

Source: HKIMR staff calculations based on the Climate Risk Measurement Survey.:

The three most commonly used indicators to measure transition risk among the survey respondents comprise carbon emission and pricing indicators (e.g., Scopes 1, 2, and 3 of greenhouse gas (GHG) emissions⁶⁴ and carbon taxes), ESG ratings and scores, and energy usage indicators (e.g., the ratio of fossil fuel to renewable energy usage). It is noteworthy from the survey results that a slightly higher percentage of surveyed banks and asset managers used carbon emission and pricing indicators than ESG ratings and scores, while the opposite condition held true for surveyed insurers. This is likely because carbon emission and pricing indicators are central to international initiatives and regulatory requirements for banks and asset managers. For instance, several banks indicated that they were grappling with disclosing under the TCFD framework, with GHG emissions being one of the most important metrics. Some of the interviewed asset managers noted that the FMCC issued by the SFC required fund managers to accelerate their assessment and disclosures of climate risk, particularly GHG emissions. Compliance with these initiatives and regulatory requirements may have led to increased use of carbon emissions and pricing metrics by banks and asset managers.

Some banks and asset managers mentioned in the interviews that they have developed client-level and portfolio-level climate assessment frameworks based on ESG or climate checklists, and utilised metrics that are closely linked to their business practices. Such metrics include carbon value at risk, which measures the impacts of rising carbon costs on a company's profitability, and emission reductions, which account for the impacts of a company's mitigating plans. Several institutions were reported to align with the Science Based Targets initiative (SBTi), which enable firms to set science-based

⁶⁴ Greenhouse gas emissions are categorised into three groups, or 'Scopes', by the most widely used international accounting tool, the Greenhouse Gas Protocol. Scope 1 covers direct emissions from owned or controlled sources. Scope 2 covers indirect emissions from the generation of the purchased electricity, steam, heating, and cooling consumed by the reporting company. Scope 3 includes all of the other indirect emissions that occur in a company's value chain.

emissions reduction targets. Advanced practices disclosed by interviewees included adopting the CDP-WWF temperature rating methodology, which is an open source methodology that can be applied at the level of an individual emissions target, a company, or an investment portfolio, and can assess the ambition of any public GHG emission reduction target.

Some respondents stated that their choice of indicators also depended on the methods and scenarios in use, along with the relevance of the data items to the underlying assets. The survey and interview respondents underscored standardisation and guidance from regulators as important for measuring, disclosing, and using these indicators.

Moreover, 61% of the survey respondents that were measuring climate risk also conducted scenario-based analyses. Of the survey respondents, 77% conducted scenario analyses through in-house modelling,65 which is more resource-demanding but can better incorporate firm-specific conditions into the model (Figure 3.6). Scenario analyses through third-party services, regulatory initiatives (e.g., HKMA climate risk stress test), and public tools were also utilised by a considerable number of financial institutions. The survey and interview participants also indicated that their usage of proprietary and third-party tools depended on their institutions' expertise level in climate risk measurement and the resources at hand. The respondents stated that they were exploring the best way to conduct scenario analyses given the lack of standardisation in the industry.66

The most commonly used scenario-based methods across the three sectors were scenario analysis and stress testing, as suggested by 85% and 71%, respectively, of the survey respondents. Catastrophe modelling⁶⁷ was applied by a substantial majority of insurers (83%), which is especially applicable to analysing physical risk in the insurance industry and the potential usage of which by banks and asset managers can be explored.68



Figure 3.6: Methods used by financial institutions to conduct scenario analyses

Source: HKIMR staff calculations based on the Climate Risk Measurement Survey.

65 In-house modelling was the most commonly adopted method across the three sectors.

Third-party services

Regulatory initiatives

Public tools

Other

In-house modelling

⁶⁶ For example, whereas HKMA GS-1 provides suggestions for Als to conduct scenario analysis and stress testing, Als need to determine scenarios and time horizons based on their business model and risk profile.

⁶⁷ Catastrophe modelling is the process of using computer-assisted calculations to estimate the losses that might be sustained due to a catastrophic event such as a hurricane or earthquake.

For more details, please refer to Box 4.1 in Chapter 4 of this report. 68

3.4. REMAINING CHALLENGES: DATA, METHODS, AND OTHER ISSUES

Although financial institutions can leverage various resources to measure climate risk, challenges remain. The challenges most cited by the surveyed financial institutions involved the availability of climate-related data, data quality issues (reliability and transparency, comparability, and complexity), and the availability of standardised and consistent methodologies.

The challenges most cited by the surveyed financial institutions involved the availability of climate-related data, data quality issues, and the lack of standardised and consistent methodologies. The availability of climate-related data was most often cited (68%) as a major challenge by the surveyed financial institutions (Figure 3.7). The survey respondents stated that it is difficult for them to locate sources of desirable data or to obtain data from various data sources simply because some climate-related data are not captured by the appropriate entities (e.g., climate targets and adaptive capacity). The currently available data was cited as far too limited in its coverage (e.g., across geographic regions, sectors, and asset classes), depth, and granularity to meet institutional requirements. The high cost of data services posed another challenge for financial institutions, especially small and medium-sized enterprises with limited budgets and resources.

Issues associated with the availability of standardised and consistent measurement methodologies were considered another major challenge, as suggested by approximately 60% of the survey participants. Whereas public and private providers offered some solutions to help address climate risk, financial





Source: HKIMR staff calculations based on the Climate Risk Measurement Survey.

institutions found it difficult to identify desirable tools and methods because of a lack of standards for selecting and determining the robustness and usefulness of models. Even when there were methods available, the survey respondents stated that they often lacked relevant knowledge and background for a good understanding and use of those methods. Moreover, current methodologies were deemed inappropriate to model the characteristics of climate risk, such as its nonlinearity and uncertainty.

The quality issues associated with climate-related data (i.e., reliability and transparency, complexity, and comparability) were also regarded as key challenges, as suggested by approximately 40% of the survey participants. Climate-related data were often regarded as unreliable because of a lack of consistency in definitions and standards, along with insufficient disclosures of data collection or integration processes. These challenges also contributed to the problem of non-comparability when data were obtained from different geographical areas and industries or with disparate estimation methods. In addition, the complexity of climate-related data posed challenges for financial institutions, given that such data should reflect the characteristics of climate risk and require extensive work to be processed. One method that financial institutions can consider is to establish a robust data management framework that provides high-level guidance to help improve the guality of climate-related data, which was discussed in our Chapter 2.

The identification of climate-related risk and a lack of expertise were considered two additional major challenges, although they were identified by relatively fewer survey respondents. Financial institutions encountered challenges in determining the relevance and materiality of climate risk to their business and quantifying their exposure to climate risk. The question of how to integrate climate risk into the existing risk management framework presented another challenge. Financial institutions also stated that there was a lack of talent with crossdisciplinary backgrounds because of a lack of professional qualifications and training programmes. In addition, the survey respondents across the three sectors indicated that they experienced additional challenges when engaging in cross-boundary and international activities. These challenges mainly concerned a lack of consistency across jurisdictions in data definition and taxonomy, data quality, and regulatory frameworks and guidance. These responses align with the challenges voiced by the interviewees related to regulatory fragmentation and development gaps across jurisdictions.

3.5. FUTURE PLANS: INCREASING INTEREST IN ADVANCING CLIMATE RISK MEASUREMENT

With the varying incentives and challenges in the path of climate risk measurement, there are some encouraging signs of the industry's appetite for progress. Of the survey respondents, 76% planned to allocate similar or more resources to climate risk measurement in the next 12 months compared with the last 12 months, as indicated by 91% of the respondents that were measuring climate risk and 60% of those that were not. The allocation plans demonstrated a split across financial institutions in different sectors and of different sizes. The respondents that planned to invest similar or more resources included 84% of banks, 71% of insurers, and 74% of asset managers. The banks' more proactive approach may be related to recent policy developments and stakeholder demand.

There are encouraging signs of the industry's interest in advancing their climate risk measurement efforts, with 76% of the survey respondents planning to allocate similar or more resources in the next 12 months.

In the near future, we can expect noticeable advances in climate risk measurement. Our survey

results show that 80% of the survey respondents who were not measuring climate risk planned to do so in the future, with 45% intending to measure in the next two years, 30% in the next two to three years, and the rest in more than three years.

The survey respondents were asked about their climate risk measurement strategies for the next 12 months. Aligning with policy developments was the most widely adopted strategy, suggested by approximately 60% of the survey participants (Figure 3.8). Resourcing also appeared to be among the top considerations, with both upskilling the current workforce and leveraging third-party resources selected by approximately 40% of the surveyed financial institutions. Given that work related to climate risk requires multi-disciplinary knowledge, both upskilling the existing workforce and leveraging the expertise of third parties can serve as effective solutions. Following instructions from headquarters was another approach, which one-third of the respondents intended to try, as many institutions

simply leveraged their headquarters' work and resources when measuring climate risk. In addition, some respondents, mainly institutions with a large amount of assets under management, planned to recruit new employees with relevant expertise in climate risk. The relatively lower percentage of respondents considering this option may be related to the current talent and knowledge gaps in the local market.

A majority of financial institutions are now measuring climate risk, and many more are making plans to do so. However, significant challenges remain in financial institutions' climate risk measurement, which mainly focus on the data and methodologies. Because of the unique nature of their business, insurers, especially P&C insurers, have established experience in measuring the impacts of climate risk, especially natural hazards. In the next chapter, we perform a deep dive into insurers' experience in measuring climate risk and explore its potential insights for banks and asset managers.



Figure 3.8: Strategies for climate risk measurement in the next 12 months

Source: HKIMR staff calculations based on the Climate Risk Measurement Survey.

Chapter 4 Leveraging Insurers' Experience

Practices and key insights

HIGHLIGHTS:

- Because of the unique nature of the insurance industry, climate risk can have concrete and all-encompassing impacts on insurers' business and operations by influencing both the asset and liability sides of their balance sheets.
- Insurers have established experience in climate risk measurement, which provides insights for other sectors of the financial services industry. They include enhancing the understanding of climate risk, broadening climate risk coverage, improving data management, strengthening the application of advanced methodologies, and facilitating the good usage of measurement outputs.
- Insurers routinely adopt natural catastrophe models to assess how natural catastrophes affect their underwriting business. These models are likely to become powerful tools for banks and asset managers in climate risk measurement.

One of the key barriers that hinders financial institutions from measuring climate risk is the lack of relevant knowledge, expertise, and resources, such as the selection and usage of climate-related data and methodologies. Because of the unique business nature of underwriting, insurers have longstanding experience in climate risk measurement, especially related to natural catastrophes. This observation is supported by the evidence from our survey and interviews, which illustrates the advanced expertise of insurers in climate risk measurement in diverse aspects. Leveraging the extensive experience of the insurance sector can be conducive to enhancing the climate risk measurement of other sectors of the financial services industry. To this end, this chapter discusses the experience of insurers in climate risk measurement, introduces the models that are routinely adopted by insurers, and explores insights for other sectors of the financial services industry.

4.1. THE INSURANCE SECTOR AND CLIMATE RISK MEASUREMENT

Insurers have been measuring climate risk longer than other sectors of the financial services industry and have accumulated considerable experience in this field. They monitor a wide range of risks, utilise broad sources of data, possess advanced expertise in implementing measurement methodologies, and make good use of measurement outputs for business development.

Long-term experience

The Climate Risk Measurement Survey asked financial institutions when they began to measure climate risk. The survey results indicate that insurers had long-term experience with climate risk measurement, with more than half of insurers (57%) beginning more than two years ago, as opposed to a smaller portion of banks and asset managers (20%) (Figure 4.1). Some insurers mentioned that they already embed climate risk in their overall risk management framework and perform data collection, processing, and model estimation for climate risk measurement on a regular basis.

Considering that a majority of financial institutions accelerated their pace of climate risk measurement within the past two years amidst developments in policies and investor preferences, insurers may have had additional motivations to begin climate risk measurement earlier than other institutions. The insurers in the survey and interviews believed that climate change might have crucial impacts on their strategic planning and risk management. This belief is largely attributable to the unique business nature of insurers in providing insurance products and



Figure 4.1: Financial institutions' experience with climate risk measurement

Source: HKIMR staff compilation based on the Climate Risk Measurement Survey.

services related to climate change, particularly natural catastrophes, which were highlighted by many of the interviewees. There are some estimates that the total economic losses caused by natural catastrophes have surged in the past few decades, as climate change have intensified and the percentage of insured losses to total losses has more than doubled.⁶⁹ This suggests the fundamental role played by the insurance industry in reducing the negative impacts of climate change on other entities and implies that climate change can pose significant threats to insurers' business and operations.

Risk coverage

In general, insurers monitor a broader range of physical risk than banks and asset managers. More than half of insurers considered the physical hazards with the highest frequency or intensity both globally and in Hong Kong, including tropical cyclones, rising temperatures, extreme precipitation and flooding, rising sea levels, wildfires, and landslides (Figure 4.2). These sources of risk are the most likely to be insured against through certain insurance products.

Figure 4.2: Sources of physical risk that are covered by financial institutions

	Insurers	Banks	Asset managers
Increasing temperatures			
Rising sea levels			
Extreme precipitation and flooding			
Tropical cyclones			
Wildfires			
Droughts			
Landslides			
Heat waves and cold snaps			

Note: A darker color indicates that it is selected by a higher percentage of the survey respondents.

Source: HKIMR staff compilation based on the Climate Risk Measurement Survey.

Figure 4.3: Impacts of physical risk on financial risks viewed by financial institutions



Source: HKIMR staff compilation based on the Climate Risk Measurement Survey.

⁶⁹ See, for example, the estimate based on the data collected from Swiss Re's Sigma Explorer, at https://www.sigma-explorer.com/index.html.

Climate risk affects both the asset and liability sides of insurers' balance sheets. On the asset side, climate risk may result in the devaluation of assets held by insurers, similar to its impacts on banks and asset managers. On the liability side, the degradation of climate conditions may lead to unexpectedly high insurance claim pay-outs. Surveyed insurers were more likely than other financial institutions to perceive that physical risk can have comprehensive effects on their business and operations (Figure 4.3). They identified market risk, underwriting risk, and credit risk as the top three financial risks affected by physical risk.⁷⁰ Market risk refers to the uncertainty associated with investment losses caused by unfavourable price changes, and credit risk refers to the uncertainty arising from borrowers' inability to repay loans. Both of these risks affect the asset side of insurers' balance sheets. Underwriting risk refers to the uncertainty of paying higher-than-expected insurance claims, which mainly impact the liability side of insurers' balance sheets.

It is notable that operational risk was considered to influence financial risks by a higher ratio of banks and asset managers than insures, driven mainly by banks. This is likely related to the discrepancy of business nature across sectors, as banks appear to rely more on physical operations than asset managers and insurers and thus are more vulnerable to physical hazards.

Physical risk is usually considered more relevant to P&C insurers that provide insurance against adverse events than to other types of insurers. However, our survey results show that life and health insurers also examined the effects of climate change on human

68% Attributes of physical assets 83% 58% Characteristics of climate and weather events 83% Damage and losses induced by physical hazards 67% 39% Insurance costs and claims related to physical hazards 67% 34% Vulnerability and mitigation/adaptation measures adopted 67% 32% Ability to recover from physical hazards 33% 32% Value chain exposures 33% 8% Other 17% Insurers Banks and asset managers

Figure 4.4: Data categories used for measuring physical risk

Source: HKIMR staff compilation based on the Climate Risk Measurement Survey.

⁷⁰ AGCB-HKIMR (2022) provides a detailed discussion of how climate risk translates into different sources of financial risks.

health and the resulting impacts on their business and operations. For instance, the top climate-related factors that were regarded as relevant to human health included extreme heat-related illnesses and severe weather events, as suggested by 62% and 46% of life and health insurers, respectively. As indicated by the interviewees, research in this field is still at an early stage, and further study is needed to better understand how climate change impacts human morbidity, mortality, and longevity.⁷¹

Climate-related data

In general, insurers use broader categories of data than other institutions to measure climate risk. Five out of the seven physical risk data categories were covered by more than half of the surveyed insurers, compared with three for banks and asset managers (Figure 4.4). Notably, more than 80% of insurers adopted the data categories of the attributes of physical assets and characteristics of climate and weather events, which are fundamental inputs into advanced modelling techniques for climate risk measurement, such as scenario-based methodologies.

In addition, the diversity of data granularity levels – i.e., the country, sector, region, firm, facility, and portfolio levels – used by surveyed insurers is among the highest in the financial services industry. Data with adequate levels of granularity are essential for producing high-quality measurement outputs. An insurer shared in the interview that an advanced system is used in its institution to produce highly accurate data of a building's location and its exposure to certain physical hazards. These results indicate that insurers are striving to increase the quality of climate risk measurement to better support their business and operations.

Insurers utilise more diverse sources of climate-related data than banks and asset managers. Although the most commonly used data sources were the same across the three sectors (public and private data providers along with internal proprietary data), insurers on average adopted more varying sources of data than banks and asset managers. Three important implications emerge from the interview findings. First, it is occasionally necessary to integrate data from different sources. For example, to convert addresses into latitude and longitude coordinates, an insurer used both public data from Google Maps and private data from Google's geocoding services. Second, it is now common to use advanced techniques to assist in the data-collection procedure. As a concrete example, one insurer applied artificial intelligence algorithms to collect data on electricity and water usage, along with building materials of specific properties. Furthermore, given that the quality of measurement outputs depends on the quality of data inputs, several insurers have put in place stringent data quality assurance processes, such as a clear delineation of responsibilities and strict rules that penalise internal teams failing to deliver high-guality data. Several insurers also used third-party validations.

Measurement methodologies and usage of outputs

The insurance sector is leading the financial services industry in the application of sophisticated modelling techniques in climate risk measurement. Compared with banks (67%) and asset managers (52%), a higher portion of insurers (86%) have adopted scenario-based methodologies in their measurement for risk management and business development.

Insurers use the outputs of climate risk measurement for various purposes, including screening out carbon-intensive projects, determining appropriate reinsurance strategies, and adjusting existing policies. For example, 30% of insurers have modified their actuarial techniques or built new actuarial models to factor climate risk into their product design.

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⁷¹ USAID (2022) provides an overview of the impacts of human health and the health sector. Under the climate-related disclosure framework that will be set out by the ISSB (IFRS, 2022), health insurers may be required to disclose the effect of climate change on human health.

Insurers have also designed new products to protect policyholders against the economic losses associated with climate risk. For example, many insurers have rolled out parametric insurance products in line with increased market demand. Parametric insurance products insure policyholders against the occurrence of specific events by paying a set amount based on the magnitude of the events, such as rainfall amount or wind speed. They are suitable for covering the potential losses arising from natural catastrophes with low frequency but high intensity. Parametric insurance has a faster pay-out and higher flexibility than traditional insurance.⁷² One insurer mentioned that it provided property and casualty coverage with pay-out in the form of carbon offsets in the event of additional emissions. These new insurance products are crucial for improving the resilience of the economy and society to climate change.

Notably, insurers continuously highlighted catastrophe models (Cat models)⁷³ in the survey and interviews, as they have been widely adopted in the insurance sector to measure the risk of natural catastrophes and the associated impacts on business and operations. Climate risk can be incorporated into the Cat models to reflect the evolution of climate change uncertainties and the associated economic losses. As recommended by leading research institutes, international organisations, and financial regulators,74 the banking and asset management sectors can also use Cat models to improve their climate risk measurement. These models may become powerful tools as climate change continues to increase the frequency and intensity of certain catastrophes.⁷⁵ Box 4.1 provides an overview of Cat models and explains how noninsurers can apply Cat models to their climate risk measurement.⁷⁶

4.2. INSIGHTS FOR OTHER SECTORS OF THE FINANCIAL SERVICES INDUSTRY

Insurers' experience in climate risk measurement provides insights for other sectors of the financial services industry, namely enhancing the understanding of climate risk, broadening climate risk coverage, improving data management, strengthening the application of advanced methodologies, and facilitating the good usage of measurement outputs (Figure 4.5). These insights can be helpful in facilitating the climate risk measurement of the banking and asset management sectors.

Enhancing the understanding of climate risk

Insurers' experience demonstrates that a comprehensive understanding of climate risk is crucial to measuring and managing its impacts on their business and operations. Some of the interviewed insurers reported that a good understanding of climate risk at a sufficiently senior level of management can provide a basis for efficient measurement at the micro level. It is also regarded by insurers as key to forming an institutional culture that considers climate risk in its strategic planning along with how business and operations should be adjusted accordingly. As climate change continues to intensify, other sectors of the financial services industry need to increase their understanding of climate risk, devote more resources to climate risk measurement, and potentially adopt structural changes to achieve the institution's targets.

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⁷² Sengupta and Kousky (2020).

⁷³ Cat models refer to a class of probability-based computerised models mainly used by insurers and re-insurers to estimate the damage to physical assets caused by natural catastrophes, along with the accompanying financial costs.

⁷⁴ See, for example, GA (2018), ClimateWise (2019), and PRA (2019).

⁷⁵ Please refer to IPCC (2021) for the latest scientific evidence on the impacts of climate change on the frequency and intensity of extreme weather events.

⁷⁶ Interested readers can find more information about Cat models from Mitchell-Wallace et al. (2017), who provide a textbook treatment of natural catastrophe modelling.

Figure 4.5: Insights for banks and asset managers regarding climate risk measurement



Source: HKIMR staff compilation based on the Climate Risk Measurement Survey.

Broadening climate risk coverage

The surveyed insurers had taken into account broad categories of climate risk for risk management and business development. With the materialisation of climate change, other sectors of the financial services industry will benefit from expanding their coverage of climate risk that can significantly impact their business and operations. As reflected in insurers' practice, embedding climate risk into the existing risk management framework can ensure that all critical climate risks are being monitored by the institutions. This arrangement can also help banks and asset managers to keep abreast of their vulnerability to climate risk.

Improving data management

Insurers use multiple categories of climate-related data from a wide range of sources, with qualified talent in place that understands how to use the data. Our interviews suggest that some insurers have applied advanced techniques such as machine learning for data collection and processing and have established stringent data quality assurance processes. In addition, some insurers have built their taxonomy or rating systems to facilitate business analysis to determine their exposure to climate risk. Other sectors of the financial services industry can learn from this experience to alleviate the challenges in data availability and reliability.

Strengthening the application of advanced methodologies

The insurance sector leads the financial services industry in applying sophisticated modelling techniques in climate risk measurement, especially the use of Cat models for assessing the impacts of climate risk on their physical assets. The models can be modified to incorporate both physical and transition risks, with the potential to be converted into a regulatory framework. These techniques and methodologies may be applicable to other financial institutions for climate risk measurement, with crosssectoral collaboration and training between insurers and non-insurers being a possible route. See Box 4.1 for more details.

Facilitating the good usage of measurement outputs

One important takeaway from our survey and interviews is that climate risk measurement enables insurers to convert climate risk factors into financial factors, such as financial losses or company solvency. Our results should be cautiously interpreted before they are used in strategic planning and decisionmaking. Similar measurement outputs can be produced by financial institutions in other sectors to facilitate their cost-benefit analysis of investment projects, the design of climate-compatible products and services, and client and investor education.

Insurers' established experience in climate risk measurement offers some insights for other sectors of the financial services industry.

Box 4.1: Applying natural catastrophe models to climate risk measurement

- How do Cat models work?

Cat models refer to a class of probability-based computerised models mainly used by insurers and reinsurers to estimate the damage to physical assets caused by natural catastrophes, along with the accompanying financial costs. Most Cat models are designed to examine the effect of a specific catastrophe, such as a tropical cyclone or coastal flooding, on a particular region. Cat models consist of four basic modules: hazard, exposure, vulnerability, and financial (Figure 4.6).

Figure 4.6: Composition of Cat models



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Source: GA (2018).
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- The hazard module reflects the frequency and intensity of catastrophes in a region based on historical observations and recent research findings. For example, it may specify the wind speed for possible storm tracks, along with the probability that such storms may occur within a given period.
- The exposure module describes the attributes of physical assets that are exposed to catastrophes. For example, it may contain information about the locations, built years, and construction materials of real properties.
- The vulnerability module uses the information from the hazard and exposure modules to derive damage curves. These curves depict the relationship between the intensity of catastrophes and its estimated damage to the physical assets. For example, it may show that when the wind speed of a storm is 50 meters per second (m/s), its damage to insured properties is equivalent to 2% of their replacement cost (i.e., the cost to completely rebuild). When the wind speed reaches 60 m/s, the damage increases to 4% of the replacement cost.
- Finally, the financial module uses damage curves and the financial structure of insurance contracts to calculate the financial losses that insurers must bear. For example, this module may show that the property damage caused by a storm with peak wind speeds reaching 50 m/s will cause an insurer to pay US\$1 million to cover its policyholders' claims.

The above procedure is often repeated (at least) thousands of times to account for the substantial uncertainty inherent in the modelling process, such as when, where, how often, and to what extent catastrophes may occur. Consequently, the model produces a distribution of likely financial losses and related statistics, such as annual average loss (AAL), which is the average event losses in a year, and the exceedance probability (EP) curve, which depicts the probability that the event losses in a year exceed a given threshold.

- How to incorporate climate risk into Cat models?

Cat models are traditionally used to measure losses under existing climate conditions. There are two main approaches to incorporating climate risk into Cat models that are relevant to the uncertainties about future climate change and the associated economic transformation (Figure 4.7).⁷⁷

The first approach is to adjust model specifications. Climate change will likely increase the frequency and intensity of some catastrophes, which can be reflected in Cat models by updating the characteristics of catastrophes in the hazard module. For example, one interviewed insurer stated that its Cat models are modified regularly, with assumptions about the frequency and severity of natural catastrophe events changing over time.

In addition, institutions can update the exposure module to incorporate socioeconomic developments that may occur during the transition to a low-carbon economy, such as the change in the attributes of physical assets and their resilience to catastrophes. Moreover, the vulnerability module can be updated to account for the adaptation or mitigation measures for tackling climate change. These measures may reduce the amount of damage caused by catastrophes, changing the relationship between the intensity of catastrophes and their estimated damage.

To nest Cat models in scenario analysis and stress testing, the hazard, exposure, and vulnerability modules of Cat models can be updated according to the assumptions made about specific climate scenarios.⁷⁸

The second approach is to scale up the resulting financial costs by a pre-calculated constant number, which reflects the overall impacts of climate risk while leaving the model specifications untouched. If there are multiple physical assets in an insurance portfolio, one can multiply the financial cost of each asset by a different constant, reflecting the possibly uneven effects of climate change on assets with varying attributes.



Figure 4.7: Two approaches to incorporating climate risk into Cat models

⁷⁷ The subsequent discussion is based on Lloyd's (2014) and PRA (2019).

⁷⁸ One obvious challenge is how to map scenario assumptions that are usually made on a global scale to changes in Cat models, which are mainly used for assessing catastrophes in a specific region. Some preliminary considerations can be found in GA (2018).

The first approach is more scientifically robust but more resource-intensive. The second approach is easier to implement but may lead to less robust outcomes. Regardless of the approach chosen, the results will not be reliable if the underlying assumptions are flawed.

- How can other sectors of the financial services industry and regulators use Cat models?

Because extreme weather events are expected to intensify over time with climate change, Cat models will become an increasingly important tool to help non-insurers better assess the impacts of climate risk on their business and operations. Financial regulators can also use Cat models to enhance their surveillance and supervision related to climate risk. Our survey results imply that small fractions of banks (5.6%) and asset managers (9.7%) in Hong Kong already use Cat models for climate risk measurement. Several research institutes and policy initiatives also shared practical guidelines and best practices for the use of Cat models by banks and asset managers.⁷⁹

Because the first three modules of the Cat models are not related to insurers' underwriting arrangements, non-insurers may directly apply these three modules to their climate risk measurement with only minor modifications. For example, they need to input the information in the exposure module about the physical assets that they hold or in which they invest. Additionally, they can update their model specifications based on their assumptions about a climate scenario.

For the financial module, non-insurers can utilise the model to calculate the distribution of monetary losses of their physical assets caused by catastrophes and then feed the outputs of Cat models into other models to obtain their required metrics (Figure 4.8). For instance, asset managers can feed the outputs into asset pricing models to calculate the reduction in asset prices and the associated market risk measures, such as value-at-risk and expected shortfalls. Similarly, banks can incorporate the outputs into credit risk models to obtain measures such as the probability of default and loss given default on the physical assets that they hold as collaterals.



Figure 4.8: Using the outputs of Cat models to derive market- and credit-risk measures

⁷⁹ See, for example, AIGCC (2021), ClimateWise (2018), NGFS (2020), and UNEPFI (2019, 2020, 2022).

Chapter 5 Enhancing Climate Risk Measurement in Hong Kong

A few thoughts for future developments

HIGHLIGHTS:

- Facilitating convergence towards a common taxonomy, standards, and methodologies was consistently cited as a key strategy by financial institutions across the three sectors, indicating the industry's appeal for a clearer and more consistent guidance.
- The survey participants' overall high level of engagement suggests that the industry is acting proactively with respect to climate risk measurement and needs the support and efforts of various parties, including governments, regulators, and industry bodies.
- Coordinated efforts between financial regulators and market participants are important. In fact, financial regulators can play a critical role in promoting a common taxonomy and mandatory climate risk disclosures. The public and market participants should deepen the awareness and knowledge of climate risk. Additional considerations include strengthening local and international collaboration, and improving the availability and quality of climate-related data and methodologies. It is also important to facilitate talent development, capacity building, and knowledge sharing.

5.1. MARKET VIEWS ON HOW TO FACILITATE CLIMATE RISK MEASUREMENT

With respect to the various challenges in climate risk measurement, the survey participants were asked to rate approaches that might be conducive to facilitating climate risk measurement in Hong Kong. Encouraging convergence towards common taxonomy, standards, and methodologies was consistently cited as a key strategy by financial institutions across the three sectors, indicating the industry's appeal for a clearer and more consistent guidance (Figure 5.1). Most of the banks underscored strategies aimed at fostering talent with knowledge and expertise relevant to climate risk and improving climate-related data granularity, coverage, and quality, whereas the insurers and asset managers highlighted collaboration across borders, sectors, and agencies. Compared with insurers, who advocated collecting industry feedback on a potential

measurement framework, asset managers were inclined to suggest the implementation of consistent and mandatory requirements related to climate risk disclosures to facilitate their portfolio management.

Encouraging convergence towards common taxonomy, standards, and methodologies was consistently cited as a key strategy by financial institutions across the three sectors, indicating the industry's appeal for a clearer and more consistent guidance.

The overall high level of engagement of the surveyed financial institutions suggests that the industry is

Figure 5.1: Market views on facilitating climate risk measurement: Top three suggestions



Source: HKIMR staff compilation based on the Climate Risk Measurement Survey.

being proactive with respect to climate risk measurement and needs the support and effort of various parties, including governments, regulators, and industry bodies.

5.2. CONSIDERATIONS FOR FURTHER ADVANCING CLIMATE RISK MEASUREMENT IN HONG KONG

Taking into account the insights of the survey and interview participants, along with recent developments aimed at facilitating climate risk measurement internationally and in Hong Kong, we propose the following calls for coordinated efforts between regulators and market participants (Figure 5.2). We hope that these considerations will contribute to the discussion on how to advance climate risk measurement in Hong Kong's financial services industry.

5.2.1. Deepen awareness and knowledge among the public and financial institutions

The overall level of public awareness and knowledge of climate change is still limited, although it has increased with the Paris Agreement and the carbon neutrality goals announced by many countries, along with the apparent change in climate patterns, such as the extreme worldwide heat waves during the summer of 2022. The interviewees agreed that more work needs to be done to educate people to view climate risk holistically and to understand the various impacts of climate risk. Raising awareness and knowledge of the effects of climate change will





Source: HKIMR staff compilation based on the Climate Risk Measurement Survey.

facilitate both behavioural change and societal support for transitioning to a green, low-emission, and climate-resilient economy. For example, as the public becomes more aware of climate change, demand for products and services with a lower volume of GHG emissions will increase on the consumer front and investments in projects and companies that are more environmentally friendly will be more favoured on the investor front.

More education on climate risk is also essential for financial institutions, which play a unique role in both making a direct contribution to emissions reductions through their business and operations and assisting their clients in achieving low-carbon transitions. The interviewees regarded a good understanding of climate risk at the management level of financial institutions as important. Financial institutions can leverage their analyses and points of view to understand how climate risk impacts their business models. Some of the interviewees stated that climate risk should not be regarded as a selfcontained risk but as an integrated risk that should be fully understood by front-line teams to help their customers understand the impacts of climate risk on the businesses.

5.2.2. Encourage a common and consistent taxonomy and standards

A precise and consistent taxonomy is urgently needed to promote market integrity and international consistency according to the survey respondents. Until now, many governments, regulators, and international initiatives have issued guidelines for green and sustainable economic activities.⁸⁰ However, multiple definitions, criteria, and standards of taxonomies may give rise to market fragmentation, inconsistencies, and challenges to accessing information and moving towards the standardisation of green and sustainable finance globally. There has been some progress in improving the comparability and interoperability of taxonomies across jurisdictions. For example, the International Platform on Sustainable Finance (IPSF)⁸¹ published the updated Common Ground Taxonomy (CGT)⁸² in 2022, which proposes areas of commonality between the taxonomies of mainland China and the EU. The CGT is helpful in lowering transaction costs and facilitating smoother cross-boundary and international green capital flows by avoiding unnecessary duplication of verifications and reducing market segmentation. In Hong Kong, following the publication of the CGT, the CASG is working towards proposing the structure and core elements of the local green classification framework for consultation.

Promoting convergence towards a common and consistent set of global sustainability disclosure standards is another top priority. A comprehensive global baseline for climate disclosure standards can provide market participants with clear regulatory expectations and improve the transparency, comparability, and reliability of corporate disclosures. It can also provide investors with information about companies' sustainability-related risks and opportunities to help them make informed decisions. Some progress has also been made in this area. The ISSB in March 2022 launched a consultation on its first two proposed standards - one on climate-related disclosures and one on general sustainability-related disclosures. The proposed standards, when finalised, would form a comprehensive global baseline of sustainability-related disclosures designed to meet the information needs of investors in assessing companies' sustainability-related risks and opportunities.⁸³ The SFC and the HKEX are engaged in a close collaboration with stakeholders to evaluate the potential implementation of this standard for Hong Kong listed companies.

⁸⁰ For example, both mainland China and the EU have issued a green taxonomy to define environmentally friendly economic activities.

⁸¹ The IPSF is a multilateral forum that aims to enable the exchange of practices and increase international cooperation on sustainable finance-related matters.

⁸² In July 2020, the EU and China initiated a Working Group on taxonomies. Its objectives are to perform a comprehensive assessment of the existing taxonomies for environmentally sustainable activities, including identifying the commonalities and differences in their approaches and outcomes. The CGT was published by the WG in November 2021 and updated in June 2022.

³³ https://www.ifrs.org/projects/work-plan/climate-related-disclosures/.

A precise and consistent taxonomy on green and sustainable economic activities, and a common and consistent set of global sustainability disclosure standards are needed by market participants.

5.2.3. Promote mandatory climate risk disclosures

First, the survey and interview participants support the wide adoption of international disclosure standards and the imposition of mandatory climate risk disclosures for both financial and non-financial corporations. A mandatory disclosure requirement will be conducive to reducing the risk of 'greenwashing'⁸⁴ and improving the availability and quality of climate-related data. Second, it is important to encourage SMEs to disclose more data and information on carbon emissions and climate risk. For example, some of the interviewees suggested providing a premium discount to SMEs that are willing to disclose climate-related data and information, given that most SMEs need to purchase insurance for their loans obtained from the SME Financing Guarantee Scheme.⁸⁵ Enhancing climate risk disclosures and reporting high-emission sectors and firms were also important to some of the interviewees. Furthermore, some of the market participants encouraged the industry to disclose and use more objective indicators, such as the carbon footprint,⁸⁶ instead of indirect metrics such as Climate Value-at-Risk.⁸⁷ The former is less dependent on the model and may be regarded as more reliable and comparable across institutions.

There has been global momentum towards climaterelated disclosures. For instance, in 2017, the TCFD published its final report, setting out recommendations for helping businesses disclose climate-related financial information; those recommendations have been endorsed or adopted by many companies and regulators worldwide. Regulators in many jurisdictions, including the US, UK, New Zealand, Japan, Hong Kong, and the EU, are all moving ahead in climate-related disclosures. More work still needs to be done, and further progress is foreseeable. In Hong Kong, the CASG announced plans in July 2021 on making progress towards mandating climaterelated disclosures aligned with the TCFD framework by 2025 across relevant sectors.

5.2.4. Strengthen collaboration across borders, agencies, and sectors

Collaboration with international organisations and governments and regulators in other jurisdictions to establish consistent green and sustainable taxonomies can also be helpful. According to the survey and interview findings, market participants with crossboundary and international business and operations are challenged by the lack of consistency across jurisdictions in their regulatory guidance and frameworks, data definitions, and taxonomy. Improved consistency across borders can strengthen the efforts and efficiency of financial institutions in climate risk measurement, especially those engaged in cross-boundary and international business and operations.

⁸⁴ Greenwashing is the process of conveying a false impression or providing misleading information about the environmental soundness of a company's products.

⁸⁵ The SME Financing Guarantee Scheme was launched in January 2011 by The Hong Kong Mortgage Corporation Limited. It aims to help local SMEs and non-listed enterprises to obtain financing from participating lenders for meeting their business needs so as to enhance their productivity and competitiveness in the rapidly changing business environment.

⁸⁶ A carbon footprint is the total greenhouse gas (GHG) emissions caused by an individual, event, organisation, service, place, or product, expressed in terms of the carbon dioxide equivalent.

⁸⁷ Climate Value-at-Risk (Climate VaR) is designed to provide a forward-looking and return-based valuation assessment to measure climate-related risks and opportunities in an investment portfolio.

Collective efforts between local governments, regulators, and industry bodies are also crucial. First, because financial institutions in Hong Kong are not yet evolved enough to deal with climate risk on their own, the survey and interview participants expect the regulatory requirements to be implemented progressively and in stages on a reasonable timeline. Clear climate policies from the governments are integral to providing guidance to market participants. Second, insurers' long-standing experience in climate risk measurement can be leveraged by banks and asset managers to improve climate risk measurement, such as by enhancing relevant knowledge, data management, and applications of sophisticated models. Third, a gap analysis of industry best practices in climate risk measurement to learn about the existing gaps and pain points in the financial services industry is critical for understanding the efforts that are required from governments, regulators, and industry players.

Market participants expect that the regulatory requirements to be implemented progressively and in stages on a reasonable timeline.

5.2.5. Improve the availability and quality of climate-related data and methodologies

Strategies need to be implemented to improve climate-related data availability and guality. Our survey results show that climate-related data availability and guality issues are among the top challenges to the market participants in the area of climate risk measurement. Climate disclosure standards and mandatory disclosure requirements can enhance both the availability and the guality of climate-related data. In fact, the SFC is reviewing fund managers' use of ESG ratings and data product providers, beginning with a fact-finding exercise to understand the business operating model of these ESG service providers as well as current market practices of fund managers when selecting and engaging with these providers. This will help the SFC prepare any guidance for the asset management industry on using ESG service providers.⁸⁸

A central data repository needs to be established to provide financial institutions with easy access to climate-related data, as highlighted by some market participants. Indeed, in June 2022, the Centre for Green and Sustainable Finance (GSF Centre) announced the launch of the GSF Data Source Repository, which contains various government data sources relevant to the assessment of physical risk in Hong Kong. It also announced plans to create a free and publicly accessible GHG emissions estimation tool with clearly disclosed methodologies that companies can use as an alternative source of information. Increasing the knowledge and awareness of the GSF Data Source Repository among financial institutions would be helpful.

⁸⁸ For more details, please refer to the website here: https://www.sfc.hk/-/media/EN/files/COM/Speech/AIMA-APAC-Annual-Forum-2022---Eng_20220906. pdf

Increasing the knowledge and awareness of climate-related data, including the GSF Data Source Repository, among financial institutions would be helpful.

Financial institutions also require standardisation of the methodologies in climate risk measurement, based on which they can establish a climate risk management framework and policies to assess their climate risk exposure on an ongoing basis and address their climate risk in the risk management framework. For example, although many regulators' guidelines provide suggestions for climate risk scenario analyses, they do not specify which scenarios and assumptions financial institutions should adopt.⁸⁹ The lack of standardisation requires financial institutions to expend additional efforts differentiating and selecting among various types of methodologies. Standardisation and instructions from regulators for climate-related models will also increase the reliability of the outputs and enable a comparison of the outputs across financial institutions.

5.2.6. Facilitate talent development, capacity building, and knowledge sharing

Financial institutions will benefit from a large pool of talent with multi-disciplinary backgrounds, as the lack of expertise in climate risk analysis is one of their major challenges. Regulators and the industry can provide training or certification programmes that provide incumbent staff and students with relevant expertise and knowledge. Public bodies and industry associations may consider offering subsidies for relevant courses and examinations to create a friendly environment, as some interviewees highlighted. There has been some progress on this in Hong Kong. For example, in the 2022-23 budget speech, measures were introduced to enrich local talent pool, comprising the provision of training to talent, the enhancement of skills, knowledge, and creativity of manpower resources, and the attraction of talent from overseas.⁹⁰ Similar measures were also announced in the Chief Executive's 2022 policy address.⁹¹ In addition, the GSF Centre has launched the GSF Training Information Repository⁹² to facilitate easy access to information about international and local GSF training and qualifications, and the GSF Internship Opportunities Repository⁹³ serves as an information platform for university students who are looking for opportunities to gain GSF-related work experience and applied knowledge to prepare for a future career in the field.

⁸⁹ HKMA (2021), MAS (2020).

⁹⁰ For more detail about the 2022-23 budget speech, please refer to the following website: https://www.budget.gov.hk/2022/eng/pdf/e_budget_ speech_2022-23.pdf

⁹¹ For more detail about the 2022-23 budget speech, please refer to the following website: https://www.policyaddress.gov.hk/2022/public/pdf/policy/ policy-full_en.pdf

⁹² For more detail, please refer to the following website: https://www.hkma.gov.hk/eng/key-functions/international-financial-centre/green-and-sustainablefinance/gsf-training-information-repository/.

⁹³ For more detail, please refer to the following website: https://www.hkma.gov.hk/eng/key-functions/international-financial-centre/green-and-sustainablefinance/gsf-internship-opportunities/.

Leveraging the expertise of external experts, such as professionals in academia or consulting firms, also appears to be a good solution. Considering that some work on climate risk analysis is highly demanding and requires professional skills, collaboration or consultation with external experts may be more direct and cost-effective for certain financial institutions. The outputs can be more concise if firm-specific characteristics are incorporated into the analysis process through good communication between financial institutions and external experts. Some interviewees stated that they had collaborated with universities to provide their staff with online courses on climate risk. Sharing best practices with use cases in the industry is an additional way to enhance the capacity of financial institutions in the area of climate risk measurement. Because it has not been long since the financial services industry began to measure climate risk, there is confusion among financial institutions about how to appropriately address climate risk. The best practices with use cases shared by regulators or industry players can serve as concrete examples that financial institutions can follow in locating data sources and developing models.

Conclusion

Hong Kong's financial services industry is positively engaged in climate risk measurement and demonstrates an increasing interest in further progress. 53% of the surveyed financial institutions were measuring climate risk, and 80% of those who were not measuring planned to do so in the future. The key drivers of climate risk measurement cited by market participants included policy developments and compliance, industry trends and stakeholder demand, reputation improvement, strategic imperatives, and overall risk management. There are encouraging signs of the financial services industry's interest in making progress, with 76% of the survey respondents planning to allocate similar or more resources to climate risk measurement in the next 12 months.

Most financial institutions consider the measurement of both physical and transition risks to be relevant to their business and operations, with approximately 77% of the survey respondents measuring both risks. Overall, transition risk was measured by more financial institutions than physical risk because of their role in pledging to meet net zero commitments in their operations and assisting their clients in achieving low-carbon transitions, in addition to some financial institutions' limited awareness, knowledge, and resources to measure the impacts of physical risk. With the intensification of climate change and developments in policies, technology, and investor appetites, it is important for financial institutions to consider all types of climate risk that may have material impacts on their business and operations.

The established experience of insurers in climate risk measurement provides insights for other sectors of the financial services industry, such as enhancing the understanding of climate risk, broadening climate risk coverage, improving data management, strengthening the application of advanced methodologies, and facilitating the good usage of measurement outputs. Because of their unique business nature, insurers have extensive experience in climate risk measurement, especially measurements related to natural catastrophes. Natural catastrophe models are routinely adopted by insurers and can become powerful tools for banks and asset managers to improve climate risk measurement.

Significant challenges interfere with financial institutions' climate risk measurement, focusing on data availability, data quality issues (reliability and transparency, comparability, and complexity), and the lack of standardised and consistent measurement methodologies. Although various sources of data can be utilised, some climate-related data are simply either unavailable or of limited coverage, granularity, reliability, and transparency. There is also a lack of standardisation for measurement methodologies, leading to invalid and incomparable outputs. Efforts to improve the availability and quality of climaterelated data and methodologies are urgently needed. A data management framework and a model-risk management framework can be helpful in effectively managing the associated data and model risks.

Coordinated efforts between financial regulators and market participants can help further advance climate risk measurement in Hong Kong's financial services industry. Considerations include deepening awareness and knowledge of climate risk, which serves as the foundation for further progress. Financial regulators play a critical role in promoting a common taxonomy and mandatory climate risk disclosures. Clear climate policies are integral to providing guidance to market participants. It is also important to strengthen local and international cooperation, and facilitate talent development, capacity building, and knowledge sharing.

Appendix A: Survey Background

The findings in this report are based on a survey entitled *Climate risk measurement: Existing experience and data issues in Hong Kong's financial industry*, conducted from July to August 2022 in collaboration with KPMG Advisory (Hong Kong) Limited. The survey aimed to obtain qualitative and quantitative information from market participants to gather insights into current practices and challenges regarding climate risk measurement in Hong Kong's financial services industry.

Overall, 106 institutions participated in the survey, including 31 banks, 21 insurers, and 54 asset managers (Figure A.1). Of these participants, six banks, four insurers, and ten asset managers provide pension-related services. The surveyed insurers enrolled cover multiple insurance lines, with 62% of them offering property and casualty insurance (without medical) and approximately 45% providing life, medical, and re-insurance.

Figure A.1: Number of participants in the survey



Source: HKIMR staff calculations based on the Climate Risk Measurement Survey.

Figure A.2: Distribution of global headquarters of the survey participants



Source: HKIMR staff calculations based on the Climate Risk Measurement Survey.

The second chart present the breakdowns of the survey respondents by the locations of their global headquarters (Figure A.2). The respondents are diverse in terms of the locations of their global headquarters, with 55% located in Hong Kong, 14% in Europe and other Asia-Pacific jurisdictions, 7% in Mainland China and North America, and the rest elsewhere.

In addition, 14 interviews were conducted with 13 organisations to gain more detailed insights, including 5 interviews with banks, 6 with insurers, and 3 with asset managers.

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The AoF is set up with full collaboration amongst the HKMA, the Securities and Futures Commission, the Insurance Authority and the Mandatory Provident Fund Schemes Authority. By bringing together the strengths of the industry, the regulatory community, professional bodies and the academia, it aims to serve as (i) a centre of excellence for developing financial leadership; and (ii) a repository of knowledge in monetary and financial research, including applied research.

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The HKIMR is the research arm of the AoF. Its main remit is to conduct research in the fields of monetary policy, banking and finance that are of strategic importance to Hong Kong and the Asia region. The Applied Research studies undertaken by the HKIMR are on topics that are highly relevant to the financial industry and regulators in Hong Kong, and they aim to provide insights on the long-term development strategy and direction of Hong Kong's financial industry.

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