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Response to the U.S. Treasury Request for Information on the Insurance Sector and Climate-Related Financial Risks

November 15, 2021

Executive Order on Climate-

Marsh McLennan: Marsh McLennan has been involved in the Climate Risk Sub-Committee of the Commodity Futures Trading Commission. Our conclusions of the Sub-Committee were that “climate change poses a major risk to the stability of the US financial system and to its ability to sustain the

Related to the above, few commercially-available physical risk models exist that seek to treat business interruption rather than property damage. There is great uncertainty in this translation–given that two similar firms may set up their operations/points of failure very differently–so it is unsurprising these models are not commercially available. As business interruption, in our experience, can have a bigger impact on business viability than property damage in the climate modelling we have conducted, this is a potential blind spot.

Climate models at present do not typically treat wide-area risks (e.g., access roads, power lines, etc.) which could cause non-damage business interruption. By focusing modelling efforts exclusively on a building's boundaries, there is likely an under-read of climate risk faced by the insured and the insurer.

A large uncertainty to the mapping and modeling component is acceptance by insurers. Even if new models are developed, carriers may not accept and/or agree with the data presented and thus will not write the cover.

The case for standardization must include completeness and accuracy of data, and the ability for use in different cases. In the market currently, there is a lack of standardization which leads to fragmented data and the above issues discussed around carriers.

First-principle insight: distance to coast

The physical and geographic characteristics of each location in a portfolio can provide valuable insight into its risk profile. By aggregating metrics of physical and geographic parameters, indicators can be developed of potentially untenable concentrations of risk. While these aggregations do not provide complete insight into the risk profile of a portfolio, they are often the first step in understanding it. They can also serve as key differentiators when considering risk-based transactions.

With the proliferation of remote sensing technology, commercial data providers have emerged to provide data points that assist in quantifying observable characteristics. Freely available open-source data provided by the USGS, the National Oceanic and Atmospheric Administration (NOAA) and other government-related scientific bodies also form datasets for specific locations. These include elevation, land use, land cover, satellite imagery and the location of water bodies.

Hazard mapping

Hazard maps are an effective way to provide quantitative risk-differentiating metrics for specific locations. Ultimately, this risk differentiation can aid in the understanding of risk aggregation, inform location-level risk valuation and support the development of site-specific reliance strategies. Commercial vendors and open-source providers are beginning to create hazard maps that reflect the impact of possible climate change scenarios. These maps help various industries understand the regional and site-specific impacts of specific perils resulting from different climate stresses.

Resolution is an important consideration when examining the utility of hazard mapping for a specific portfolio of risks. Hazard-map analysis can be applied in many resolutions, and the appropriate degree of precision will generally depend on the peril under consideration. For example, flood hazard mapping, including digital flood insurance rate maps (DFIRM), is most informative when the risk is shown down to individual structures, because flood hazard varies significantly with differences in

with detailed site specific exposure information with all available attributes, which still proves to be a challenge in today's insurance market.

Scenario modeling

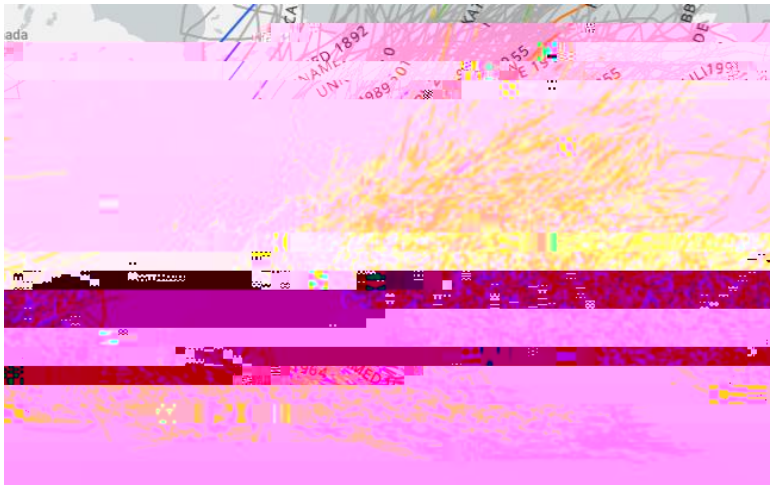
Hazard maps and first principles insight data do not account for correlation between locations. This is a limiting factor when examining how physical risks, such as flooding, may affect a region or a portfolio of risks, because not all locations will experience the same level of damage. Scenario modeling and mapping is a useful tool to examine how a portfolio of risks will respond to specific chronic and acute physical risks. This GIS-based exercise usually involves overlaying a particular hazard scenario footprint onto a portfolio of risks to identify which locations will be directly impacted. Loss estimation can also be incorporated into the modeling to estimate the financial impact of a particular scenario.

Scenario models represent either historic or hypothetical events used for a variety of risk quantification exercises. Historic event reconstructions provide valuable benchmarks for the resilience of a schedule of risks. Hypothetical events, such as the Realistic Disaster Scenarios published by Lloyds of London, are used to stress test portfolios and reinsurer balance sheets. Scenario modeling is also used to investigate event types that are expected to become more prevalent in a changing climate.

Catastrophe modeling

Catastrophe models are a collection of acute physical risk scenarios (called a stochastic catalog) that have calibrated the frequency and severity of the events to historic observations. Their most common application is for probabilistic portfolio-level risk analysis, and they are one of the primary tools used to quantify physical risk for risk transfer solutions. However, advances in technology, specifically around computational efficiency, have made possible greater application of catastrophe models along the value chain of risk quantification and transfer value. For example, the National Flood Insurance Program (NFIP) is currently leveraging a number of catastrophe models in their Risk Rating 2.0 initiative, which is aimed at aligning their rating methodology with current industry best practices.[1] Major commercial model vendors include AIR Worldwide, RMS, KatRisk and CoreLogic, each of which provides its own suite of models addressing acute physical risk. Major perils include hurricanes, earthquakes, floods, wildfires and severe convective storms.

Figure 1: Map of all historical events used to build and calibrate catastrophe models stochastic catalog.



[1] https://www.fema.gov/flood-insurance/work-with-nfip/risk-rating.

In addition to a catalog of hypothetical events, catastrophe models include a financial engine, which translates physical damage into structure and portfolio-level loss. This component is critical for indemnity-based risk transfer, as it allows both parties to correlate the loss magnitude to a certain probability. After a major catastrophic event, costs for material and labor generally increase as a function of availability. Catastrophe model providers include this in their loss estimates, by including loss adjustment factors calibrated on historical observations of increases in rebuild costs after events in different regions.

Catastrophe model vendors have experience in adjusting modeled frequencies to account for specific climate regimes. The most common adjustment accounts for different sea surface temperature

Figure 2: Modeling Catastrophe. Anatomy of a catastrophe model with necessary inputs for each section from Franco et al. 2020. Used to identify components suitable for adjustment to align with historical experience. This process is justified through extensive an analysis into historical portfolio losses.

Figure 3: Flood model release by year.
Approximate number of new yearly releases of flood risk models deployed for usage within the (re) insurance industry as announced in global press releases (compiled via an internet search of insurance publications such as Insurance Journal, Intelli

a new flood-related peril into other modeled perils, such as storm surge for hurricane models or tsunami for earthquake models.

train models. Continued

data from insureds that may be readily available to insurers (e.g., size, age and location of property; type, age and miles driven for an automobile).

Mercer has a handful of tools that may be useful to FIO and their constituents in seeking this data:

Table 2: Mercer climate transition tools.

Tool	Uses	Output
Analytics for Climate Transition "ACT"	Enables investors to assess climate risk across all assets	Data will be used to prioritize and detail improvement. Outline climate strategy.
Climate Risk Analyzer "CRA"	Test resiliency of portfolios under certain asset allocation	Undertake climate scenario analysis and stress testing for client awareness of climate on portfolios.
MercerInsight	Database of low carbon and climate transition investment strategies	Support for clients in implementing climate change investment strategies.
Climate and ESG Peer Benchmarking	Database of E227.s73.63 552anc	

Insurance Markets and Mitigation/Resilience

10. What factors should FIO consider when identifying and assessing the potential for major disruptions of insurance coverage in U.S. markets that are particularly vulnerable to climate change impacts?

Marsh McLennan: This is a challenge for individual consumers, businesses, local governments, state governments and at the federal level. Populations have different exposure to natural catastrophes and loss characteristics prior to introducing climate-related risk, which future events will only further stress and amplify future losses to life, infrastructure and GDP.

Capital is an essential cornerstone. Who are the constituents driving the direction of capital, what is the level of capital required for different lines of coverage, what are the rating agency views of certain markets and what is the required industry return on capital? Which leads to different questions, one of which is—who drives these discussions on solvency?

Prior to climate considerations, there was historical profitability in this sort of vehicle for investors. It was met with a bit of volatility, but this sort of investment provided diversification from other financial instruments. The structure of the industry was one of traditional indemnity. For large-scale catastrophe risks, we saw the emergence of new mechanisms to transfer risk. Fair plans, are essentially run like state insurance pools, and in instances have become much larger than initially anticipated. Other sorts

climate change, and the damage or loss of these components could take years to recover. For regional, state and ultimately the scale of the federal government, the scale of material losses will be informed by the peril, the region, and the category of physical risk—whether it is acute, chronic or an accumulation of severe acute threats.

The interconnections of a range of societal variables in conjunction with the severity of impact of a physical risk event will ultimately give rise to consequences that have not yet been contemplated—or, at least, that have not yet been recorded. Seven key social variables are spatial footprint, infrastructure repair, supply chain, liability of utilities, economy and employment, home price depreciation and population migration.

Table 3: The full spectrum of climate change risk for local to super-regional areas of the United States

Variable	Limited	Minor	Moderate	Major	Massive
Spatial footprint	Neighborhood to community	City	Metro regions	State(s)	Super regional
Infrastructure repair	Limited	Weeks to months	Quarters	Years	Irreversible damage
Supply chain	Negligible	Price increases	Lack materials	Breakdown	No available sources
Liability of utilities	None	Tougher legislation	Increased utility costs	Bankruptcy	Government takeover
Economy and employment	Strength on rebuilding	Stagnation/ reduced growth	Reduced employment opportunities	Recession with interest rate implications	Depression
Home price depreciation (HPD)	Negligible	Temporary HPD/incidental defaults	Extended HPD/ moderate		

the future. These events could increase the degree of economic disruption and potential insurability. A

Figure 7: Confidence in climate change signals and direction of peril trends.

Each US catastrophe peril is ranked on a four-category confidence scale (low, medium, high, very high) based on the scientific consensus of the Intergovernmental Panel on Climate Change, the US Fourth National Climate Assessment and an extreme weather assessment of climate change from the National Academy of Sciences in 2016. The size of the bubble represents the economic loss level as measured by NOAA's billion dollar database from 2000-2019. For projections 20-40 years into the future (2040-2060), the color of the bubble indicates the projected percentage change in economic loss due to climate change influences alone.

14. How should FIO assess the availability and affordability of insurance coverage in U.S. markets that are particularly vulnerable to climate change impacts? In your response, please discuss how to balance maintaining insurer solvency with the need to address the availability and affordability of insurance products responsive to perils associated with climate-related risks, particularly for traditionally underserved communities and consumers, minorities, and low- and moderate-income persons.

Marsh McLennan: As climate change leads to increases in the frequency and severity of perils such as wildfire and flood, the risk-based premiums in private insurance markets will increase. These increases will be uneven, concentrated in hotspot regions most exposed to the perils in question. As Marsh McLennan's report "Sunk costs: The socioeconomic impacts of flooding" argues, this may lead to a cycle of more frequent disasters and rising inequality because socioeconomically disadvantaged groups are more likely to live in at risk areas, more likely to remain in at risk areas and more likely to move into at risk areas as properties devalue.

Extending insurance cover among vulnerable communities can break this sequence and enable people to recover. Government can consider a number of approaches for how to do so. These range

Insurance Sector Engagement

18. What role or actions might states take to encourage the insurance sector's transition to a low emissions environment and an adaptive and resilient economy? In your response, please discuss whether efforts by states to encourage the development of new insurance products, to promote sustainable investment and underwriting activities, and to address protection gaps created by climate-related financial risks might facilitate this transition.

Marsh McLennan: States need to come to a consensus of a shared commitment to resilience. Without a level of accountability, we will have some actors that are progressive at advancing this agenda, and others that are not. Those who are not engaged will drag down the insurance marketplace.

As mentioned above, implementing programs that include incentives in the form of lower deductibles and higher limits are a way the insurance industry can encourage the transition to a low emissions environment. The same could be done with certain natural catastrophes, like wildfire. We have seen a resistance to write cover for the peril in certain states, notably California. Coverage then becomes unavailable or unaffordable.

While working to reduce the impact of climate change, we realize there is an element of evaluating returns. Mercer has worked with the state of California to assess insurance company investment portfolios and incentivize socially-beneficial investments. We feel capabilities in this space in assessing insurer investment portfolios could be of great interest to other states as well as FIO.

If the goal is to help proactively combat climate change, the insurance industry's incentives should focus on the components that humans and businesses can control. For example, clearance of dead brush on public and private lands, adding emergency sprinkler systems and inspection and correction of possible issues with transmission lines are mitigation measures for wildfire risk. These actions equate to less risk of large fires spreading along with entities taking responsibility for their own lands. This then should equate to a financial incentive as these measures are expenses in the name of the greater good. Marsh McLennan and Guy Carpenter have a strong partnership with the Institute for Business and Home Safety (IBHS). Their mission is to reduce unnecessary losses under extreme weather, and to support safer homes and businesses. They advance this effort through original research at their full-scale lab facility in Richburg, SC, by advancing consumer and public policy to prevent unnecessary loss and by providing action points for insurance companies and their policyholders towards more resilient homes and businesses.

These IBHS action points, informed by research at their facility, can offset damage from hazards including wildfire, wind, and hail, for both commercial and residential structures. Wind resilience is best supported by a properly attached, sealed and covered roof, with a continuous load path from the roof through the walls to the foundation. Wildfire resilience improves by maintaining a defensible space

around a property that is free of combustible materials, with noncombustible building materials and screens on intake vents. The IBHS has also developed new industry test protocols for shingle resilience to hail, informed by original field research into hail characteristics. Such action points are increasingly used by insurance companies and policyholders toward improved resilience, and recognition of reduced losses from these resilience measures.

The IBHS is also actively involved in advancing building code measures at both the national and state level, supported by their *Rating the States* publication on building code adaptation and enforcement. The IBHS has also developed a set of resilience measures to surpass the minimum design thresholds of building codes—called the *FORTIFIED standard*, supported by extensive research at their facility. Over recent years, the State of Alabama Department of Insurance has offered wind mitigation credits to homeowners that adapt their homes to the FORTIFIED standard, both for new construction as well as retrofit. This “Strengthen Alabama Homes” program has met with considerable success, with over 3,00130804qQQq0.000008871 0 595.32 841.2 84-36oo000a6464dontp46>5801[o000ag0 G[()-3(ec)-3(og)4l4[O)-4(6a4ET

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