WHITE PAPER

Navigating Climate Stress Testing

A Comprehensive Approach

MathWorks®

Introduction

In the evolving landscape of financial risk management, climate risk emerges as a critical and challenging element for institutions worldwide. The ability to assess and mitigate the impact of climate-related risks on credit portfolios is not just a regulatory expectation but a strategic necessity. Traditional risk assessment methodologies, while robust for historical and market-driven risks, fall short in predicting and managing the long-term and multifaceted nature of climate risks. In this paper, we explore the imperative for financial institutions to evolve their risk management frameworks to include climate stress testing, offering insights into methodologies, challenges, and innovative solutions for navigating this uncharted territory.

Why Climate Risk Matters in Credit Risk

Regulatory Compliance: There are increasing demands from regulators that require the integration of climate risk into risk management practices.

Financial Impact: Climate-related events have a direct effect on asset values and loan portfolios.

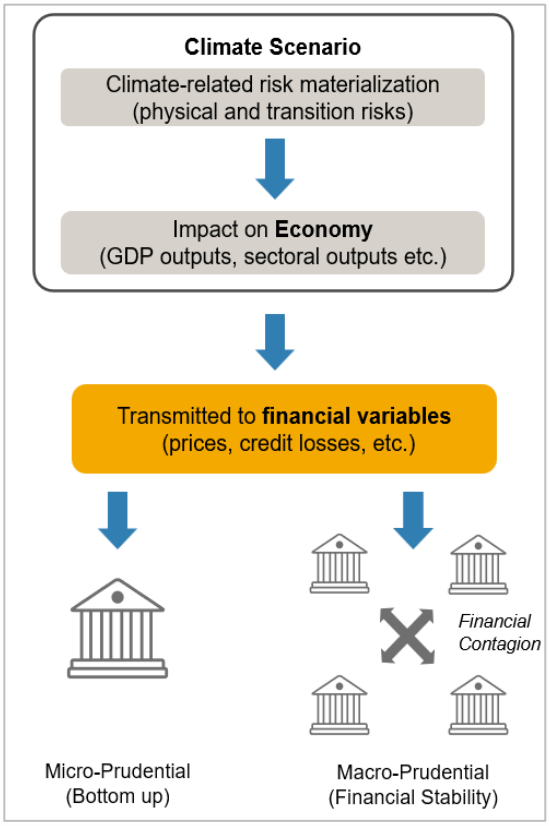
Market Expectations: There is growing pressure from investors and consumers for financial practices to be climate-responsible.

Key Concepts and Methodologies

Climate Stress Testing vs. Traditional Stress Testing: Traditional stress tests assess a financial institution's resilience against economic downturns and market volatility, typically over a short- to medium-term horizon. Climate stress tests, however, extend this horizon to decades, incorporating the long-term impacts of physical and transition risks associated with climate change. This shift necessitates a broader scope of scenario analysis, data collection, and model adaptation.

Physical and Transition Risks: Climate stress tests must account for two primary risk categories:

- **Physical risks** include the immediate impacts of climate-related events, such as floods, wildfires, and storms, on financial assets and operations, as well as longer term chronic risks like sea level rises.
- **Transition risks** arise from the shift toward a low-carbon economy, including policy changes, technological advancements, and shifts in market preferences, which can affect asset valuations and creditworthiness.



Climate stress testing.

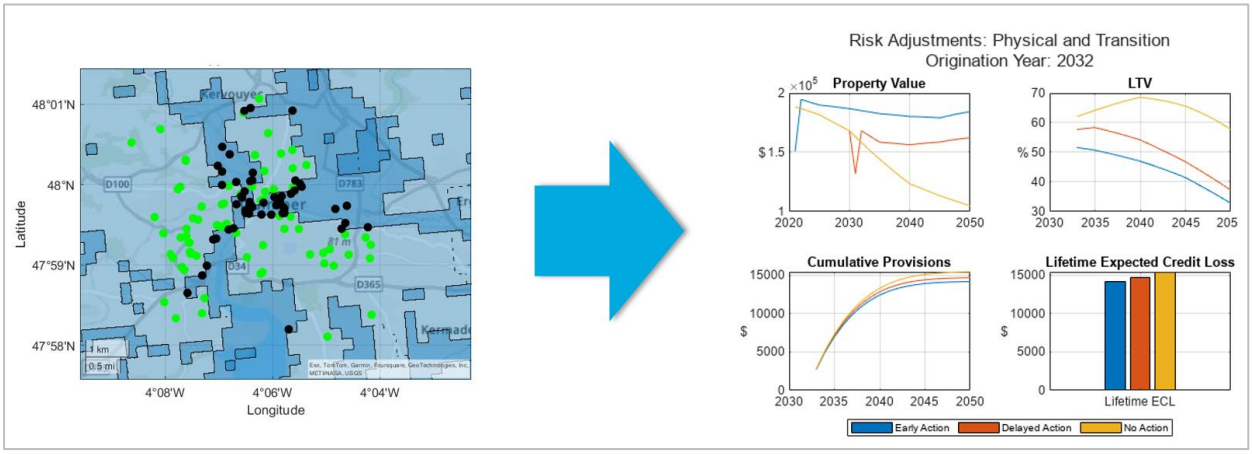
Incorporating Climate Scenarios: Essential to climate stress testing is leveraging climate scenario frameworks such as the NGFS scenarios, IPCC scenarios, or scenarios from MIT's Economic Projection and Policy Analysis (EPPA) model. NGFS and IPCC scenarios outline potential adaptation pathways for the financial sector against climate-related risks and policy

shifts, vital for evaluating credit risk implications. Distinctively, the EPPA model from MIT goes a step further by providing not just projections but a distribution of outcomes for each climate scenario. This unique feature allows for a more nuanced analysis of economic and technological changes under varied climate policies, capturing the range of possible impacts on the economy. By integrating these detailed scenario distributions, financial institutions can deepen their understanding of the potential variability in climate risks, offering a richer, more informed basis for strengthening their risk management frameworks against the uncertainties of climate change.

Data Challenges and Solutions: Implementing climate stress testing is crucial for financial institutions to understand and mitigate climate-related risks. This process is underpinned by key methodologies, such as the adaptation of financial models to include climate projections and the handling of physical risk data. Challenges include navigating diverse data sources, such as satellite imagery for physical risks and economic forecasts for transition risks and adapting this data to fit financial models. The ability to effectively manage and preprocess this data—ensuring accuracy in different coordinate systems and appropriate scaling—is fundamental to creating reliable risk assessments.

Integrating Climate Data into Risk Models

The integration of climate data into risk models is a critical step toward comprehensive climate risk management. This stage demands sophisticated data management strategies to handle the variety and complexity of climate information, from emissions data to physical risk indicators. Institutions must refine their models to incorporate this data, requiring adjustments to account for the scope of climate impacts. By developing modular frameworks, financial institutions can ensure that their risk models are adaptable, capable of incorporating a wide range of climate data types, and aligned with evolving climate scenarios and policies.



Integrating physical risk data into credit risk models.

Integrating climate data into traditional risk models enhances their capability by adding new variables and scenarios that reflect the long-term impacts of climate change. Adjustments might include updating probability of default (PD) models to factor in economic changes predicted under various global warming scenarios or modifying loss given default (LGD) estimates to account for the rising frequency of catastrophic climate events. By embedding

climate data into risk models, financial institutions can achieve a more nuanced understanding of how climate-related factors might influence credit risk. This enhanced perspective is critical for developing more resilient financial strategies and ensuring long-term sustainability in the face of climate uncertainty.

Model Development

Adapting to climate change requires financial institutions to update their risk management frameworks by creating and using models that accurately capture climate dynamics. Addressing this challenge, Modelscape offers a solution by combining extensive quantitative finance tools from MathWorks with advanced AI, mapping, and image processing capabilities. This combination facilitates the development of sophisticated models that can analyze a wide range of climate scenario data and assess their potential effects on financial risk.

Developing models from scenarios.

Utilizing Modelscape, institutions can construct dynamic, climate-aware risk models. The platform's modular design allows for the seamless incorporation of new climate data, facilitating ongoing adjustments to models in line with evolving scientific understanding and regulatory guidelines. This ensures that risk models remain both current and compliant, grounded in the latest climate projections and data analyses.

Model Deployment

Effective deployment is critical to leveraging these models within broader risk management strategies. Modelscape streamlines this process, ensuring that sophisticated climate risk models are integrated efficiently into operational workflows. The platform supports scalable deployment, making complex climate risk analyses accessible to decision-makers through intuitive interfaces and reporting tools.

Model Validation

Given the forward-looking nature of climate models, traditional historical data validation methods face limitations. Instead, validation within Modelscape emphasizes scenario analysis and sensitivity testing, assessing model performance across a spectrum of potential future climate conditions. This approach allows for the evaluation of models based on their robustness and adaptability to various climate outcomes, rather than solely historical accuracy. Such rigorous validation is crucial for building confidence in model predictions and ensuring that financial institutions can make informed decisions under conditions of climate uncertainty.

In essence, the development and deployment of climate-informed risk models via Modelscape equip financial institutions with the means to integrate complex climate considerations into their risk assessments. This approach not only enhances the resilience

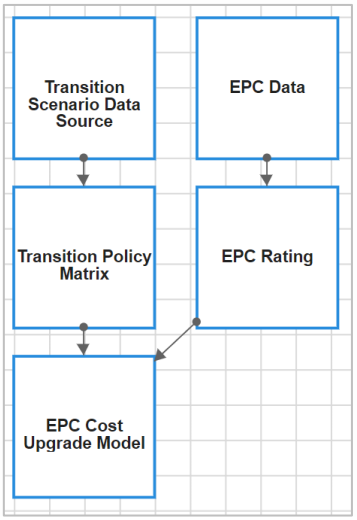
of financial strategies against climate-related uncertainties but also aligns risk management practices with global sustainability goals.

Governance and Reporting

As financial institutions incorporate climate risk into their credit risk models, the governance and reporting of these models become increasingly important. Effective governance ensures that models are used correctly, remain compliant with evolving regulations, and are consistently updated to reflect the latest climate data and risk assessment methodologies. Meanwhile, transparent and accurate reporting is vital for communicating risk to stakeholders, from internal decision-makers to regulators and investors.

Governance with Modelscape:

Modelscape provides a robust governance framework designed to meet these needs through:



Managing model dependencies in Modelscape.

- **Comprehensive Oversight:** Centralized monitoring of model performance, usage, and compliance with regulatory standards.
- **Version Control and Audit Trails:** Detailed tracking of model changes, updates, and access, facilitating accountability and transparency.
- **Workflow Management:** Streamlined processes for model review, approval, and deployment, ensuring that only validated models are used in decision-making.
- **Dependency Tracking:** Oversight of data sources and model dependencies, enabling quick responses to new information or changes in climate projections.

Reporting:

Accurate and effective reporting is facilitated through Modelscape's advanced capabilities, allowing institutions to:

- **Visualize Risks:** Generate dynamic visualizations and dashboards that present complex climate risk data in an accessible format.
- **Custom Reports:** Produce tailored reports that meet the specific needs of various stakeholders, from detailed technical analyses for risk managers to summary overviews for executive leadership.
- **Regulatory Compliance:** Automatically generate reports that comply with current and forthcoming regulatory requirements regarding climate risk disclosure.
- **Scenario Analysis:** Offer insights into the impacts of different climate scenarios on credit risk, providing a comprehensive view of potential future challenges.

Governance and reporting through Modelscape ensure that financial institutions can manage climate risk models effectively, maintaining the integrity, reliability, and relevance of their risk

assessments. This structured approach supports informed decision-making, compliance with regulatory expectations, and transparent communication with all stakeholders, thereby enhancing the institution's resilience to climate-related financial risks.

Conclusion

Integrating climate risk into credit risk management is no longer optional for financial institutions—it's essential. As climate change continues to pose significant challenges and opportunities, adopting advanced, climate-informed risk models becomes critical. Platforms such as Modelscape play a crucial role in this transition, providing the tools needed for effective data integration, model development, governance, and reporting.

The path forward requires a commitment to innovation, adaptability, and sustainability. By leveraging the comprehensive capabilities of Modelscape, institutions can not only navigate the complexities of climate risk but also contribute to global efforts to combat climate change. The financial sector has a pivotal role to play in shaping a resilient future, and the time to act is now.

Learn More

Explore Further with MathWorks

- Discover how MathWorks can transform your approach to climate risk in credit risk management. Visit our dedicated climate finance page ***here*** for more insights and solutions.

Connect with Our Experts

- Have questions or need guidance on where to start? Our team is here to help. Contact us at ***climatefinance@mathworks.com*** for personalized support and to discover how we can assist in enhancing your climate risk management practices.

Want a Demo of the Platform?

- See our solutions in action and understand the impact they can make on your climate risk analysis and reporting. Schedule a demo by reaching out to us at ***climatefinance@mathworks.com*** and witness firsthand how MathWorks can elevate your risk management capabilities.

MathWorks: Accelerating the pace of responding to climate change.