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Physical Climate Risk Stress Test:

An Evidence-based Approach

Introduction

Introduction

- Evolving expectations from regulators and businesses challenge Financial Institutions (FIs) to reassess their financial resilience

- Emerging threats such as climate change and geopolitical tensions increase uncertainty

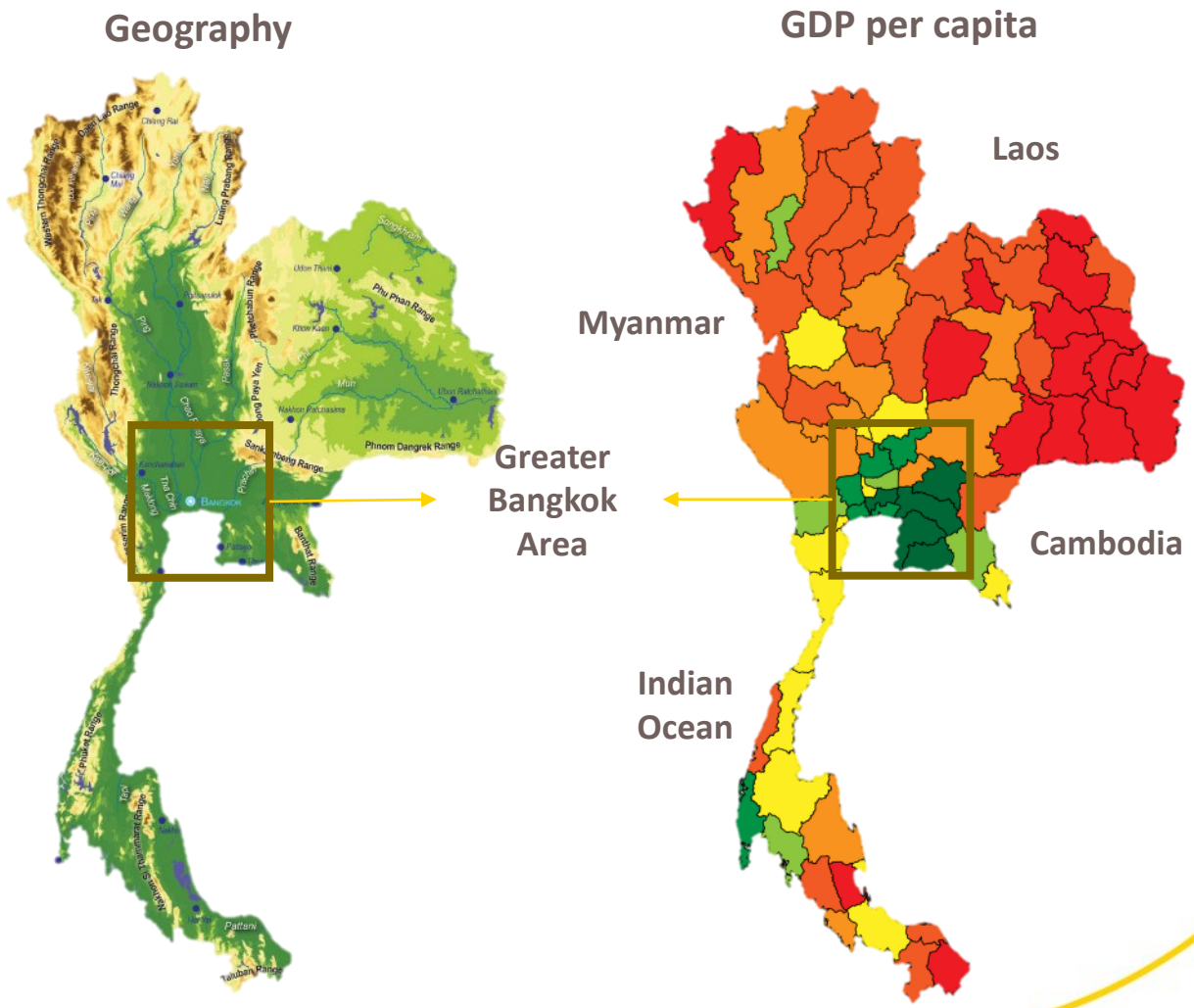
- Advanced risk modelling techniques are critical to:
  - Understand complex and interconnected risks
  - Support data-driven, forward-looking decision-making
  - Strengthen financial and strategic responses

Physical Climate Risk Stress Testing

Physical Climate Risk in Thailand

Background

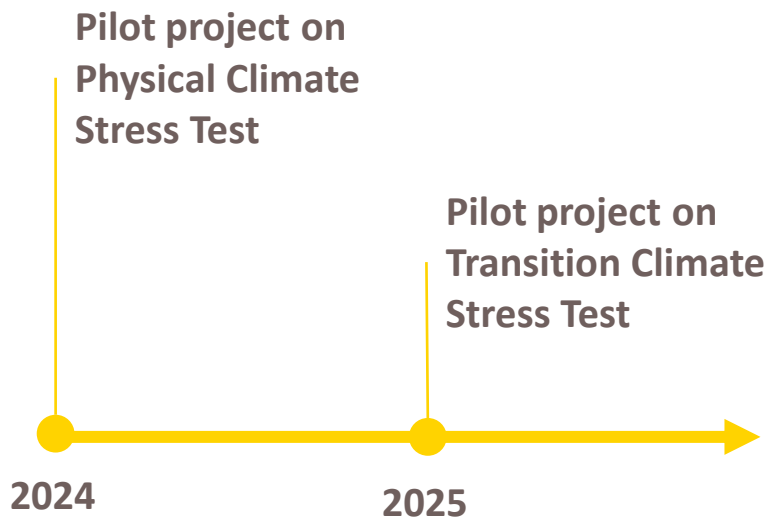
- Flood is the most potent natural hazard event in Thailand, especially across the central plain area
- Economic activities also center around greater Bangkok area down to the eastern seaboard
- Thailand has faced major floods in the past decade. Hence, there are historical data to study from



Supervisory Physical Climate Risk Stress Testing

Background & Key Challenges

BOT Climate Stress Test Timeline

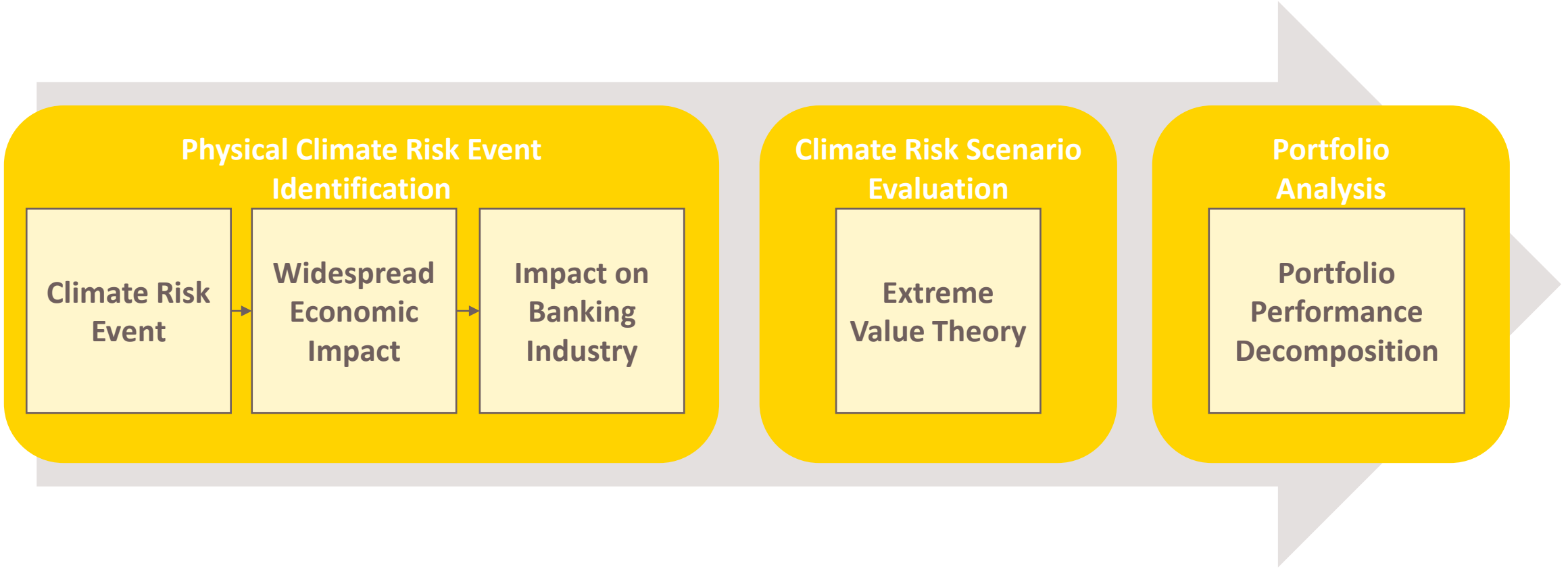


Key Challenges

- **Data Limitations**: limited granularity data and the lack of data infrastructure at the national level to sufficiently support analysis framework
- **Scenario Development**: evaluation of plausible stress scenario that would address the unique localized nature of climate risk
- **Lack of Expertise**: limited technical expertise in climate science within banking industry to address the complexity of climate event
- **Developing Regulatory Framework**: regulatory requirements are under development. Hence, the lack of clarity for banks

Physical Climate Risk Stress Testing

Evidence-Based Approach

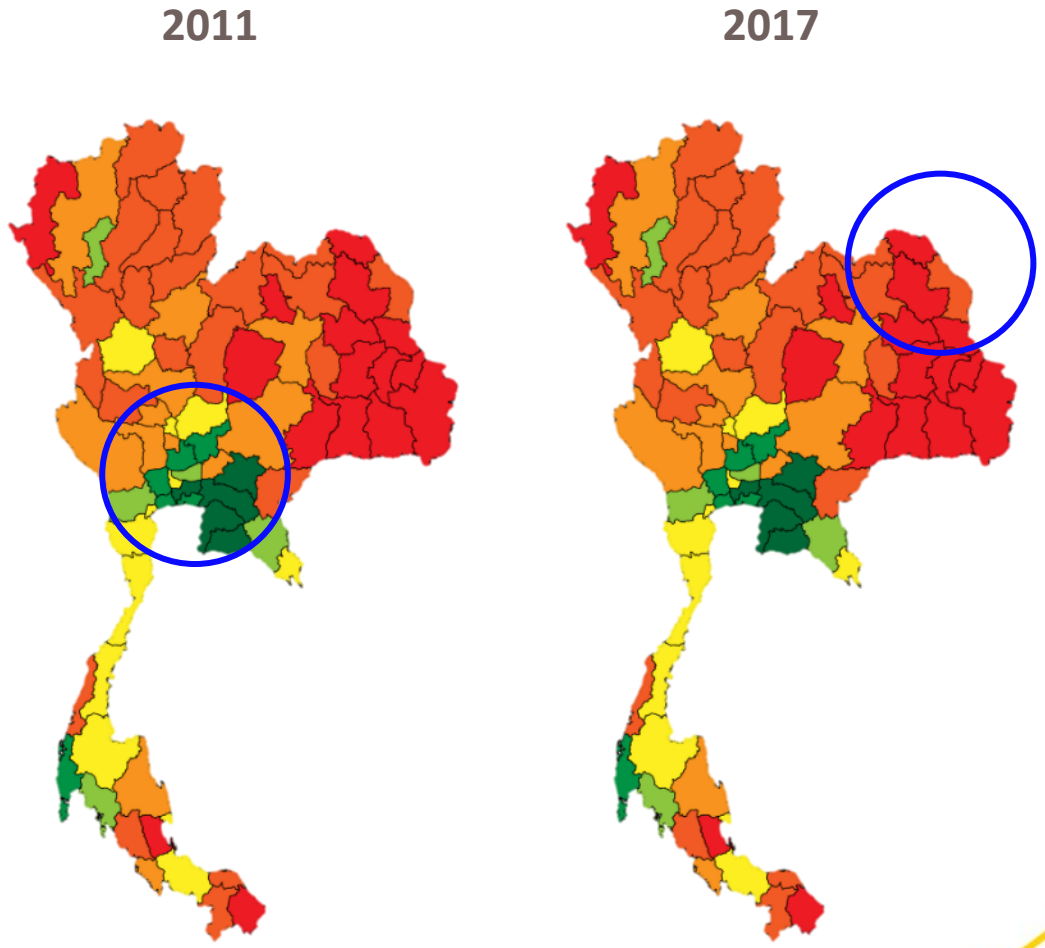


Physical Climate Risk Event Identification

Climate Risk Event Identification

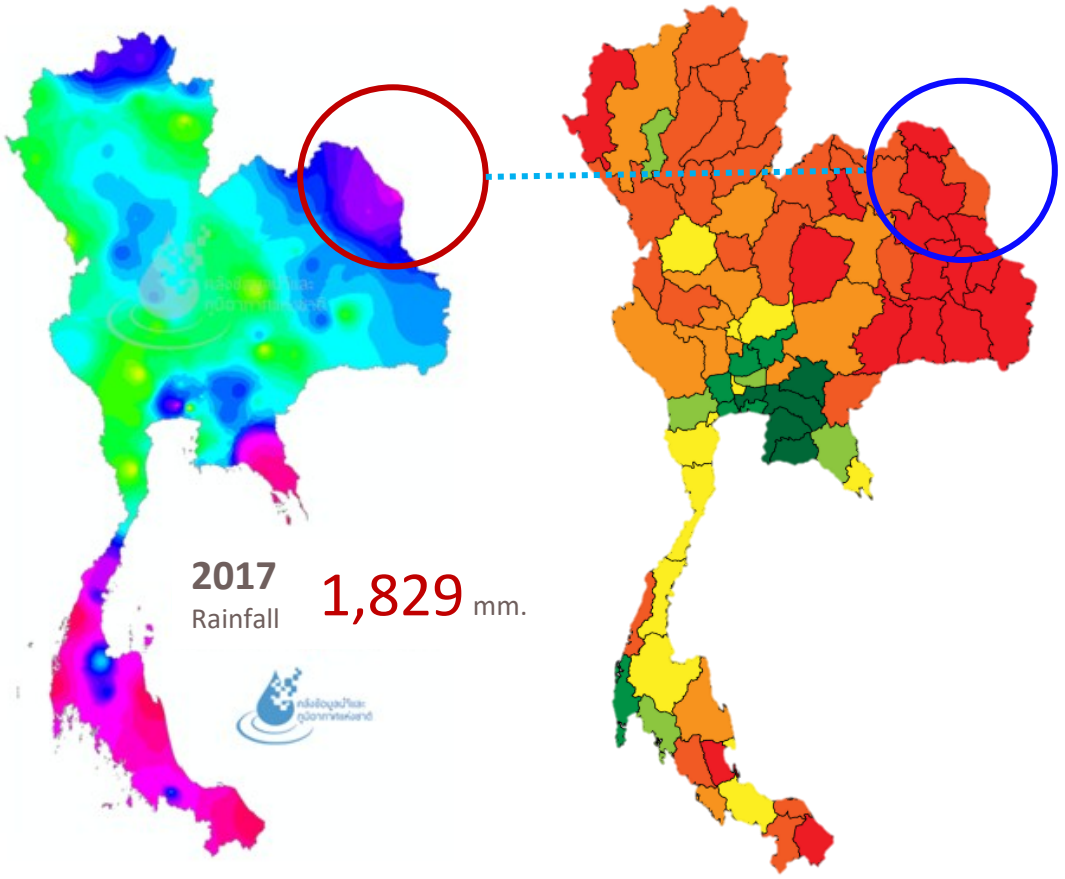
Overview of Flood Events in Thailand

- In the past 20 years, there are at least 2 major floods in Thailand during monsoon season. There are 2 notable flood events in 2011 and 2017
- In 2011, the most devastating flood to date. The flood concentrates in the central plain region of the country
- Due to different weather pattern, the 2017 flood hit Thailand at different regions in Northeaster and Southern part of Thailand
- Although both events are flood, the economic impacts were different. Hence, the understanding of the nature of climate risk on economy and banking is critical in stress scenario development



2017 Flood

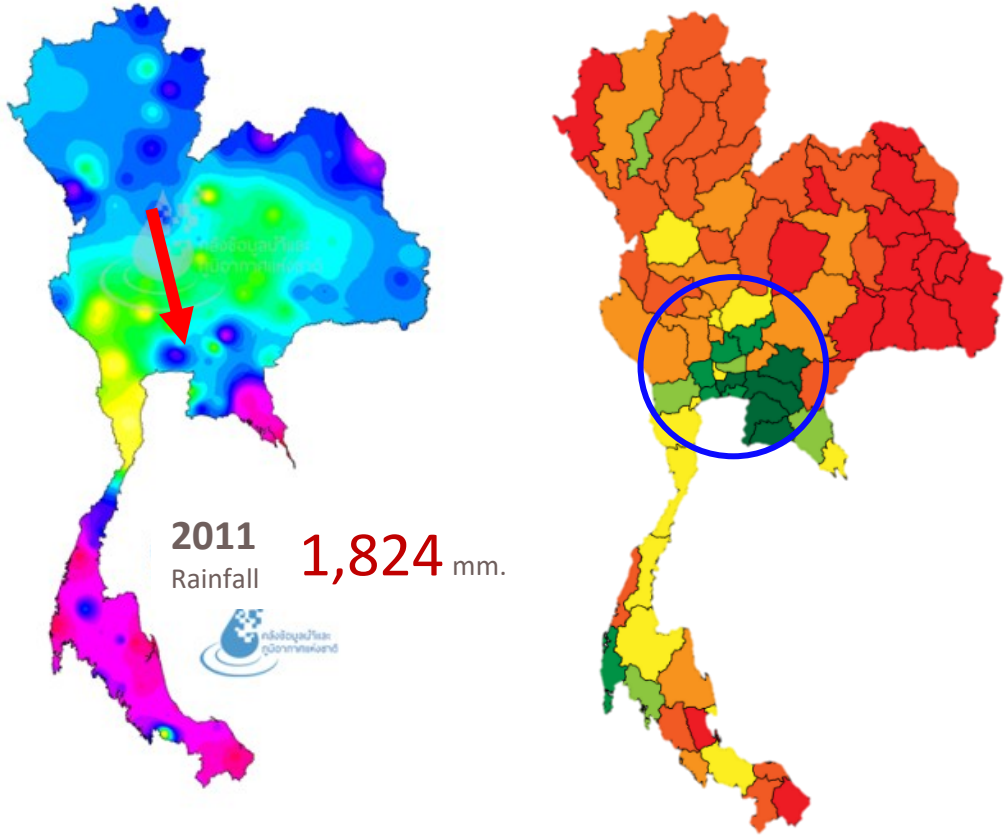
- The 2017 Floods were caused by heavy monsoon rains. Noted that the average rainfall amount was similar to year 2011
- However, the 2017 floods were localized primarily affected northern and northeastern provinces (30 out of 77 provinces). Moreover, the flooding last for few weeks
- The economic impact was estimated around **$300 million USD** where the impact were on agricultural and rural communities and did not disrupt global supply chain



Source: Hydro Informatics Institute (Public Organization)

2011 Flood

- The 2011 flood was caused by intense monsoon season with multiple tropical storms and poor water management
- The 2011 flood in Thailand was one of the most devasting flood in Thailand
  - 65 /77 provinces
  - 815 deaths
  - 13.6 million affected people
- The economic impact was
  - **Total Damage and Losses:** USD 46.5 billion. Mostly came from the manufacturing sector due to flooding in industrial estates in Ayudhya and Pathum Thani
  - **GDP:** The floods reduced real GDP growth in 2011 by 1.1% from pre-flood projections. However, reconstruction efforts that started in 2012 were expected to increase real GDP growth in 2012 by 1.7%. Without reconstruction, projected real GDP would have fallen by USD 1.7 billion in 2012



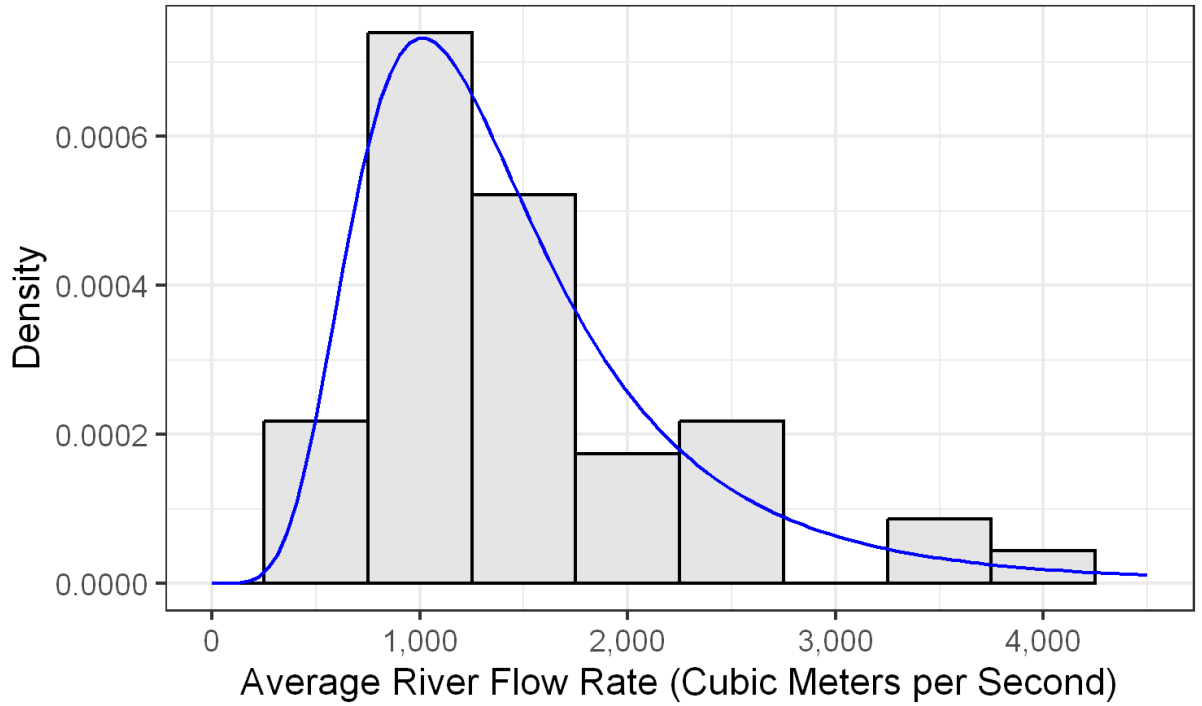
Source: Hydro Informatics Institute (Public Organization)

Climate Risk Scenario Evaluation

Climate Risk Scenario Evaluation

Extreme Value Theory - Analysis

- Useful climate scenario must be **extreme but also plausible**. Hence, we adopt EVT to guide us the likelihood of the extreme climate events.
- **EVT is suited for this task because**
  - **Focus on extreme events:** Unlike traditional statistical tools, EVT is designed for the study of extreme event
  - **Quantify tail risk:** enable us to link the severity to associated probability
- **Key climate-related data:**
  - In our analysis, we conduct analysis using multiple key flood-related measurements i.e. rainfall or river flow runoff rate.
  - On the RHS, we select the **river flow runoff rate** from the upstream water station as our measurement for flood event.

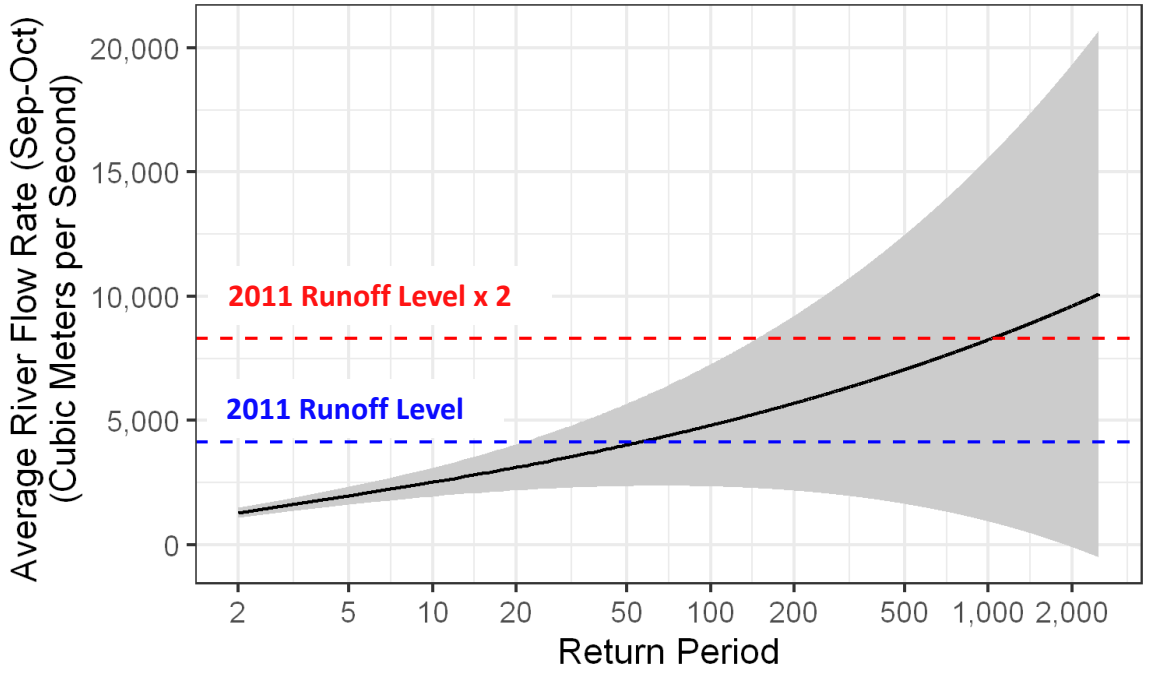


Source: Royal Irrigation Department

Climate Risk Scenario Evaluation

Extreme Value Theory - Inference

- EVT model is performed as shown in the picture on the right
- The black line illustrate the point estimated of return level where the grey area show the 95% confidential interval
- Consider the runoff level at 2011 Flood level the return period is about 1:50 years events shown with the blue line
- If we double the 2011 river flow rate level, such event will be 1:1000 years event
- Usually, 1:100 years event is selected for supervisory climate stress test
- This help us navigate our thoughts on climate scenario in terms of the severity and the likelihood.



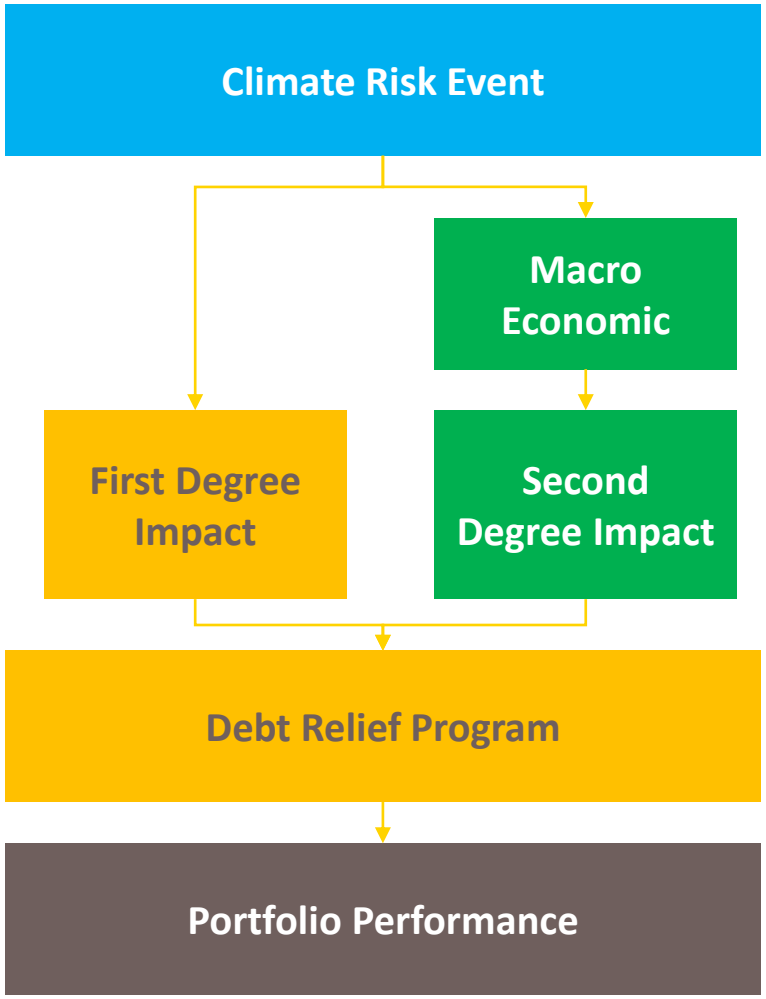
Source: Authors

Portfolio Analysis

Portfolio Analysis

Flood Impact Transmission Channel

- Transmission linkage to portfolio performance could be separated into 2 channels via direct & indirect impact to customers
- Direct impact to customers from flood would be through any financial hardships causing directly through physical damage from a flood event. Direct impact usually occurs during and/or right after a flood event
- Due to the direct impact, there would be a debt relief scheme to alleviate instant impact in the short term
- Indirect impact to customers are from prolonged economic impact on their income or livelihood of customers. Indirect impact could take periods of time to manifest themselves



Portfolio Analysis

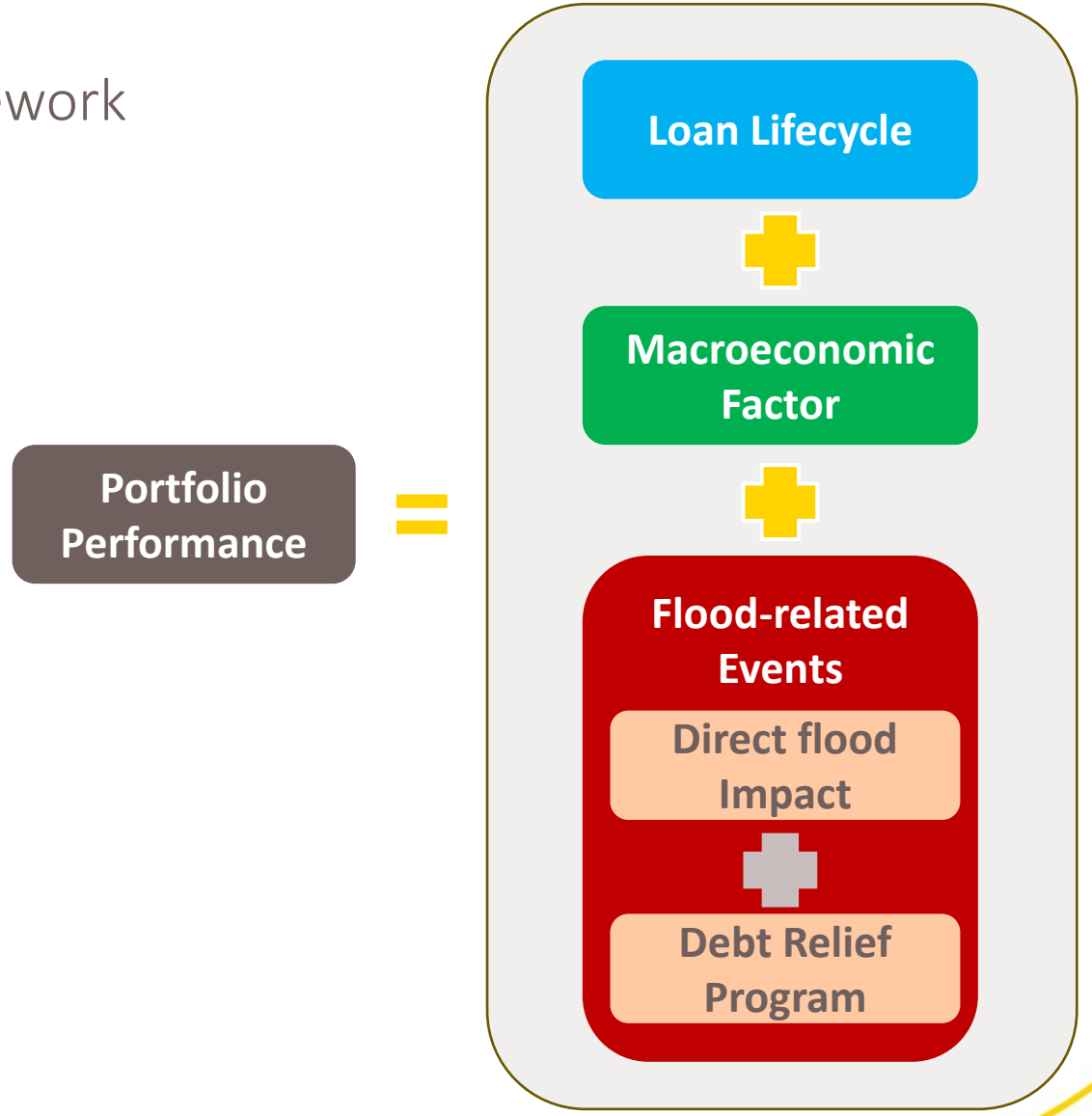
Portfolio Performance Decomposition Framework

I. Loan lifecycle effect would establish expected default rate during normal circumstance without flood

II. ***Indirect*** flood impact could be captured through the deterioration of macroeconomic factors to form a baseline default rate

III. ***Direct*** flood impact would then be captured by the difference between the estimated default rate and the actual default rate during the period prior to the debt relief program

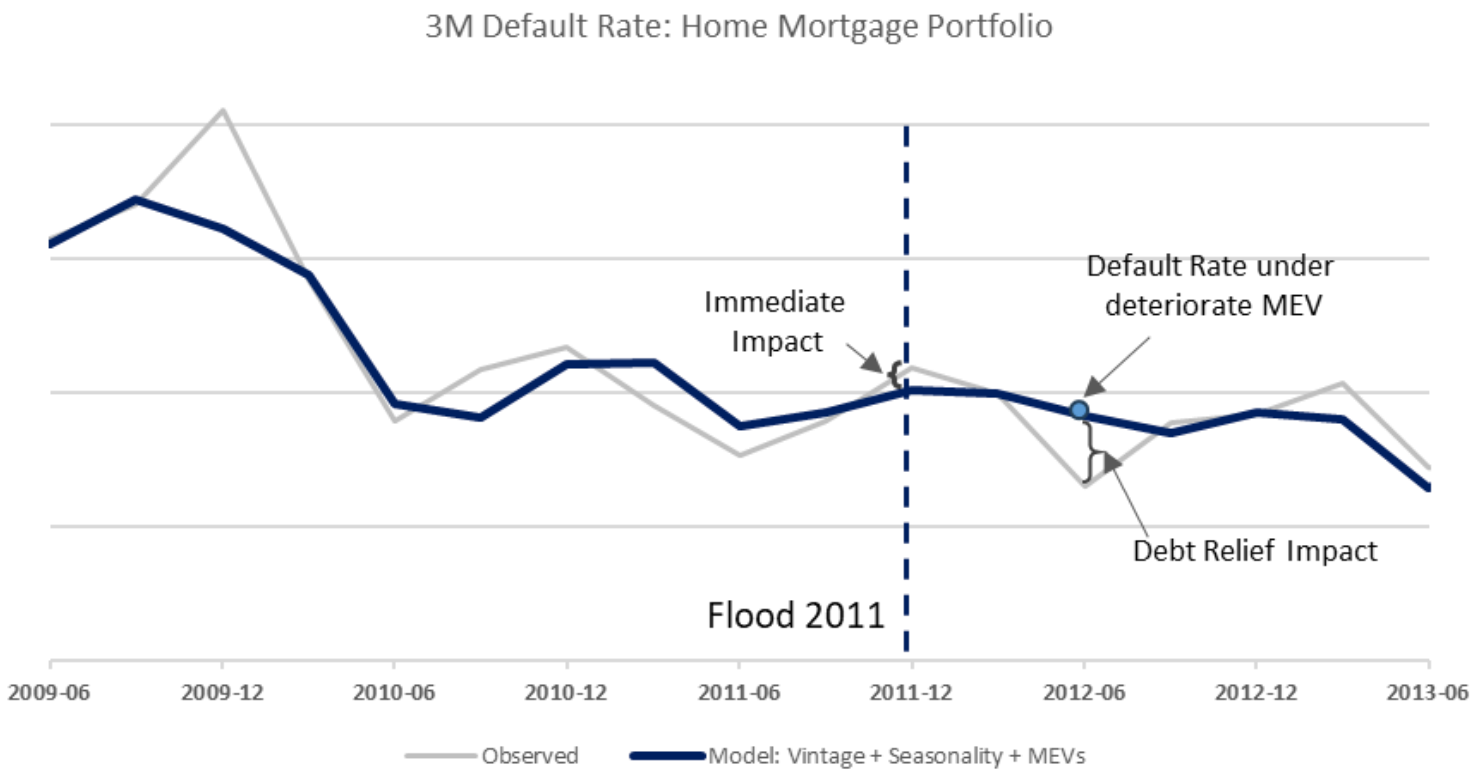
IV. ***Debt Relief Program*** could be isolated by the difference between the baseline default rate and the actual default rate during the debt relief program



Result

Decomposition of flood impact

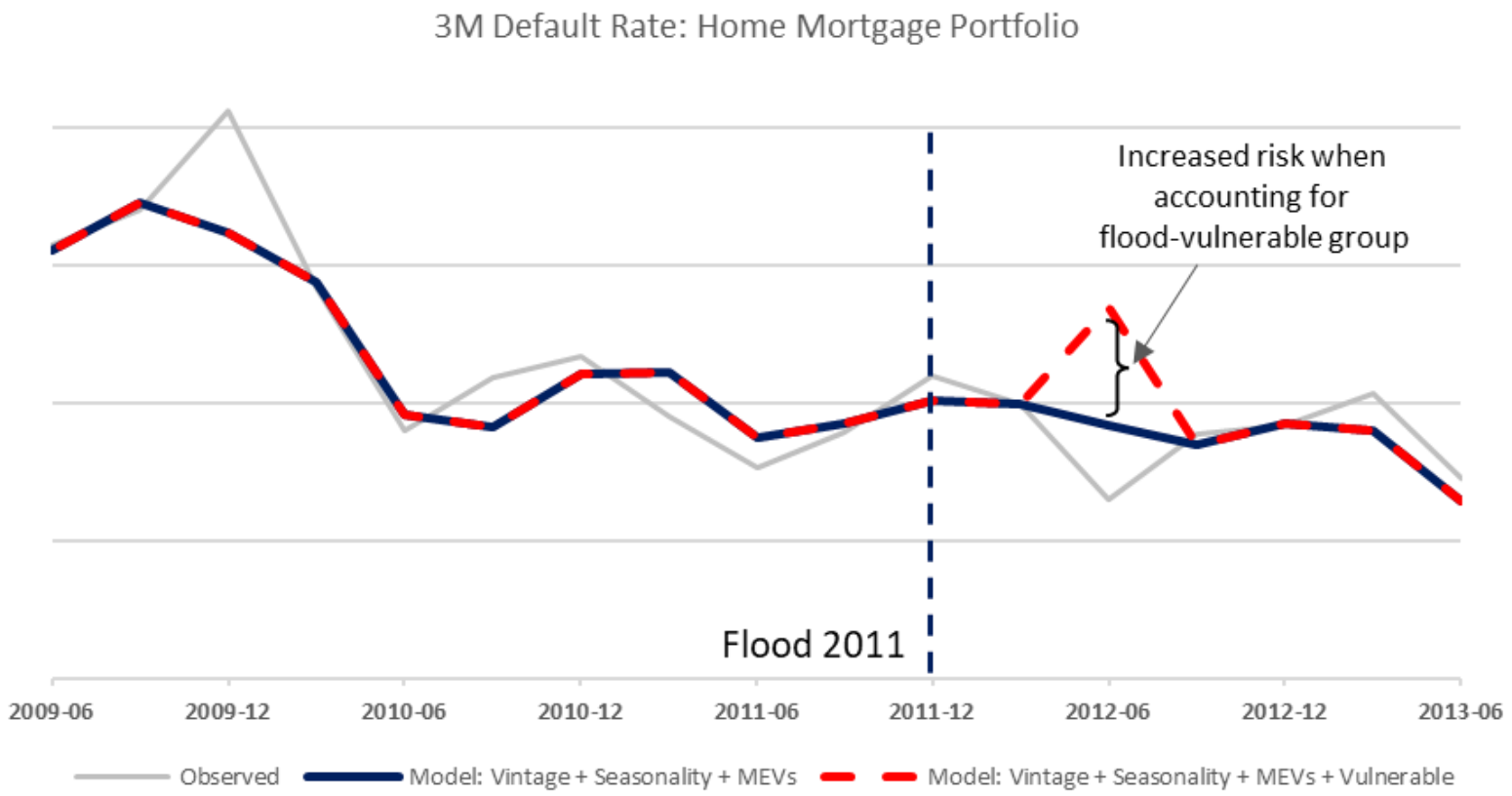
- The **grey line** represents the actual 3m default rate of home mortgage portfolio
- We incorporate lifecycle, seasonality, and macroeconomics variables into estimation, represented by the blue line
- We observe an immediate impact but it is very small
- Default is expected to increase caused by deteriorated MEVs but actual default rate is lower due to debt relief program



Result

Decomposition of flood impact with vulnerable group

- We proxy customers who participated in the Debt Relief (DR) program for the vulnerable group
- The disparity between the actual default rate of the DR group and its vintage estimate could be regarded as additional defaults attributable to the flood, represented by the red line.
- This can be viewed as an upper bound of the flood impact.



Conclusion

Physical Climate Risk Stress Testing

Caveat

- **Challenges in Observing Flood Impact**
  - The observed data was affected by multiple factors especially government/ bank response such as debt relief program or long-term soft loan
  - The decomposition approach attempts to isolate the flood-impact and associated relief program from the other factors (loan lifecycle, macroeconomic conditions)

- **Changing Economic and Environmental Context**
  - **Household debt levels:**
    - 2011: Low debt levels allowed flexibility for additional borrowing
    - Present: High household debt (90% of GDP) limits access to loans for flood restoration
  - **Improved water management:**
    Post-2011 investments in water management may reduce harm from similar flood events.

Conclusion

- **New Challenges Require New Thinking**
  - Emerging risks call for innovative modelling approaches, not just incremental adjustments
  - We must evolve our frameworks to stay relevant in a dynamic risk environment
- **Coherence Enables Action**
  - Coherent analysis across the entire framework helps reveal underlying risk drivers
  - Clear structure supports effective risk management and decision-making
- **Context Is Everything**
  - The same problem in a different context becomes a different problem
  - Effective solutions require context-aware modelling—one size doesn't fit all
- **Stay Focused on the Goal**
  - It's easy to get lost in detail, but the objective matters most
  - Stress testing doesn't always need perfect accuracy at the micro level—credible insights at the aggregate level suffice

Thank You

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