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# Life Conference 2022

23-25 November, ACC Liverpool

**#LifeConf**





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# Asset & Climate Modelling

An approach to modelling  
climate risk using casual  
models

Adél Drew

Tatiana Egoshina

**#LifeConf**



# Agenda

1. Climate change
  2. Risk
  3. Causal Modelling
  4. Case Study: Modelling approach
  5. Case Study: Scenarios
  6. Case Study: Results
- 



# Climate Change 2022 Headlines

Tuesday 19 July 2022 telegraph.co.uk No. 51,997 £2.50

## The heatwave has driven us all mad

Michael Deacon: The broadcasters seem to think Britons are helpless babies

# The Daily Telegraph

BRITAIN'S BEST QUALITY NEWSPAPER

## Record highs, travel chaos, schools close ... and it's going to get hotter

Warnings that emergency services may be unable to cope as UK endures a second day of searing temperatures



### Prince Charles: 'alarming' heat has confirmed my climate fear

THE Prince of Wales said yesterday's "alarming" record temperatures proved him right on the climate change message.

The Prince has waged a decades-long campaign on the environment but has frequently expressed frustration that it has progressed little.

Speaking at a garden party to mark his 75th anniversary at the Duke of Cornwall, he insisted to the Daily Telegraph's staff to "reach Mr. Zoro by the early 2030s."

He told guests gathered at Boscawen House, Lanwiltsham: "If I may say so, these commitments around Net Zero have never been more vitally important as we all gather under today's alarming, record temperatures across Britain and Europe. I have tried to indicate the quite some time, the climate crisis really is a genuine emergency and taking it to utterly essential - for Cornwall, the country and the rest of the world."

*'As I have tried to indicate for quite some time, the climate crisis really is a genuine emergency'*

The Prince expressed sympathy with the 500-plus Cornish residents who were invited to the party for "having to put up with this inordinate heat," which he called a "rather typically British" "rather a mad dog and Englishmen going out on the mad dog man moment."

He said: "That you are all very resilient and courageous."

Earlier, the Duchess of Cornwall said she was going to "take off like Mary Poppins" as she carried a basket.



Is this the end of the movie star? You love her so much right now! The top tracks by Kelis - ranked

Friday 12 August 2022 12:51 PM From £3.85 for subscribers

# The Guardian

News provider of the year

## Drought alert: new rules on way as climate crisis bites



Ministers set to impose restrictions in England today to cut water use

As a drought took hold across southern England, the government is set to impose water restrictions in England today to cut water use.

The Environment Secretary, Michael Gove, said: "The scale of the drought is unprecedented for many years, and we are now in a position where the water is going to be in short supply."

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### Trolls in To Divia Fake Accounts To Intensify

Linda Sarsour woke on Jan 2017, logged onto the internet, felt sick.

The weekend before, she stood in Washington at the head of the Women's March, a mobilization against President Donald Trump that surpassed all expectations. Crowds had begun forming before dawn, and by the time she climbed up onto the stage, they extended farther than the eye could see.

More than four million people around the United States had taken part, experts later estimated, placing it among the largest single-day protests in the nation's history.

But then something shifted, seemingly overnight. What she saw on Twitter that Monday was a torrent of focused grievance that she targeted, largely advocating for the rights of Muslims, she had faced the pushback, but this was of a different magnitude. A question began to form in her mind: Do they really hate me that much?

That morning, there were things going on that Ms. Sarsour could not imagine.

## 'HISTORIC' DAMAGE

HURRICANE IAN'S AFTERMATH



Southwest Florida wakes up to devastation from storm's unprecedented wind and water, as long recovery begins

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# Climate Change

## The regulator's view



Regulators have increasingly turned their attention to climate change risk

The aim of regulations are to ensure that financial institutions:

- Consider climate risk in business decision making and strategic planning
- Effectively disclose and report on climate-related risks and opportunities
- Adopt a consistent and reliable means of assessing, pricing and managing climate-related risks
- Incorporate ESG factors into investment management decisions
- Incorporate financial risks from climate change into existing risk management processes
- Use scenario analysis to inform risk identification and to estimate the impact of financial risks arising from climate change
- Consider the impact of climate risks on the ability to meet obligations towards policyholders and other key stakeholders



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# Climate Change

The regulator's view: Thematic feedback from the PRA's Dear CEO letter Oct 22

## Modelling

"More progress is required to embed physical risk in corporate modelling."

"For insurers, examples of effective practice [in scenario analysis] demonstrated by some firms included an ability to model a wide range of physical vulnerabilities in their assessment of underwriting risk, and the ability to identify and address the limitations of the third-party models used."

"As part of their RMF work, some firms exhibiting effective practice were able to demonstrate that climate risk had been appropriately factored into their quantitative analysis; for example through well-developed quantitative climate risk modelling capabilities and utilisation of prudent assumptions and proxies where data challenges existed, coupled with concurrent work to address the data gaps identified"

"All firms should be able to explain to their supervisors, how they have got comfortable that any material climate risks are appropriately capitalised."

## Capital

"In the majority of cases, firms did not provide sufficient contextual information [on capital adequacy] to enable a reader to fully understand their analysis. For example, firms often provided minimal information on modelling approaches, model types, underlying assumptions, judgements, proxies, and consequent uncertainties."



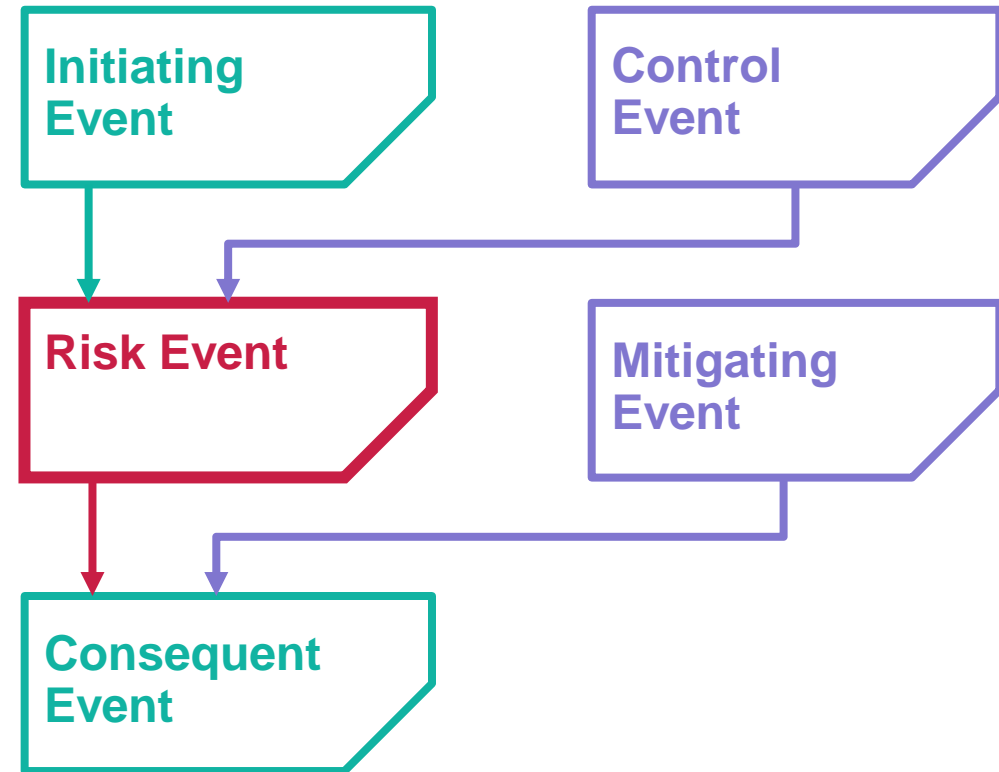
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# Risk

## The theory

At a base level, a risk is simply an *event* characterised by a causal chain of associated events involving:

- The *risk event* itself
- Another *consequent event*
- One or more *initiating events*
- One or more *control events* which may prevent the initiating events from causing the risk event
- One or more *mitigating events* that help avoid or reduce the consequent event

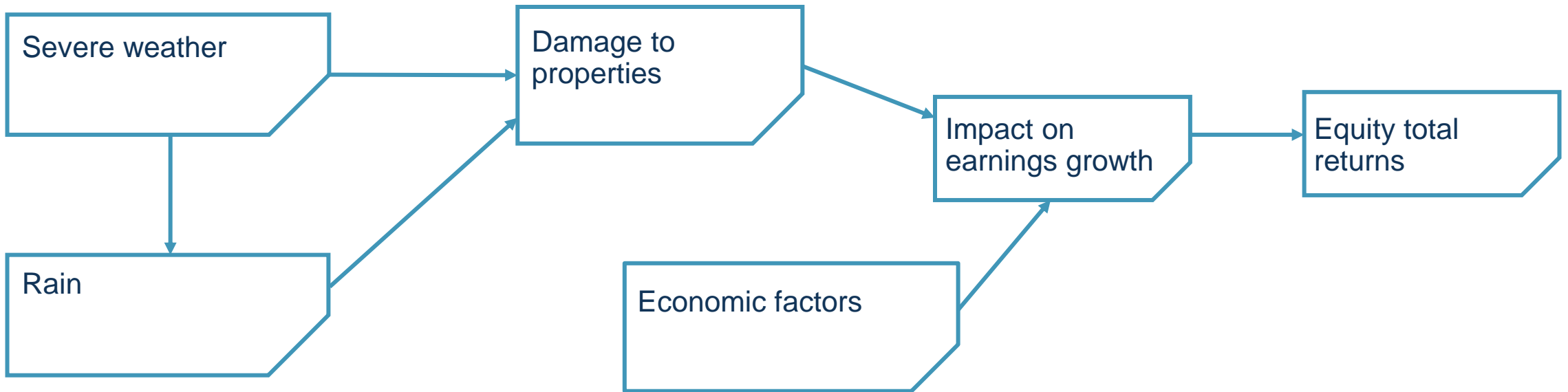






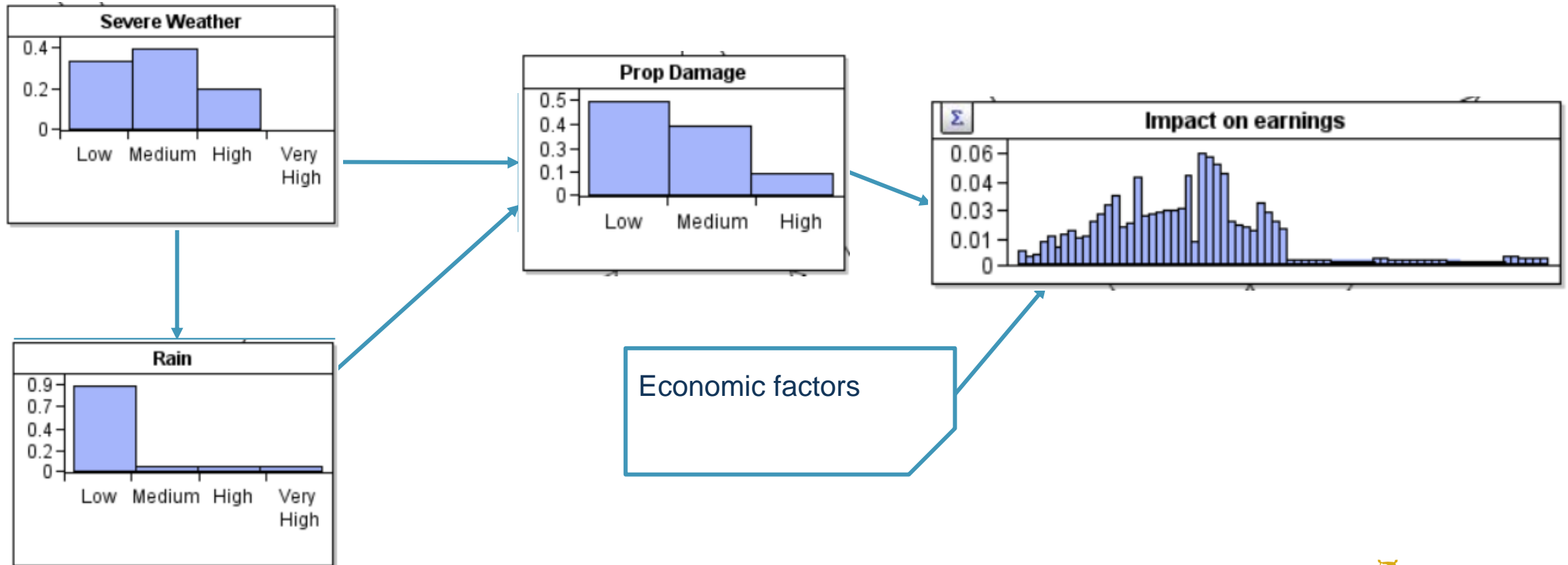
# Causal Modelling

Example: impact of climate change on a portfolio of property equities



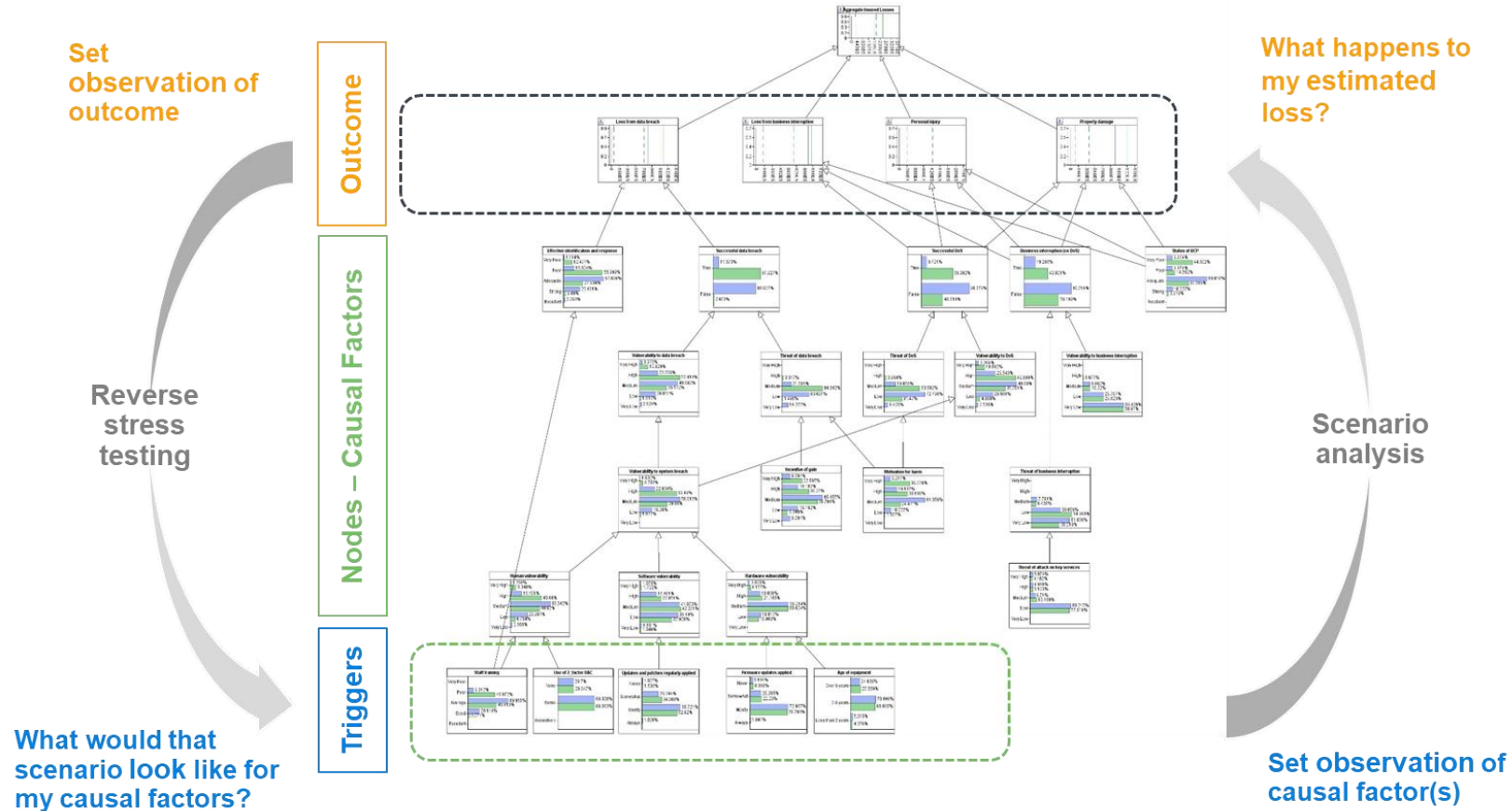
# Causal Modelling

## Example: calibration



# Causal Modelling

## Example: outputs



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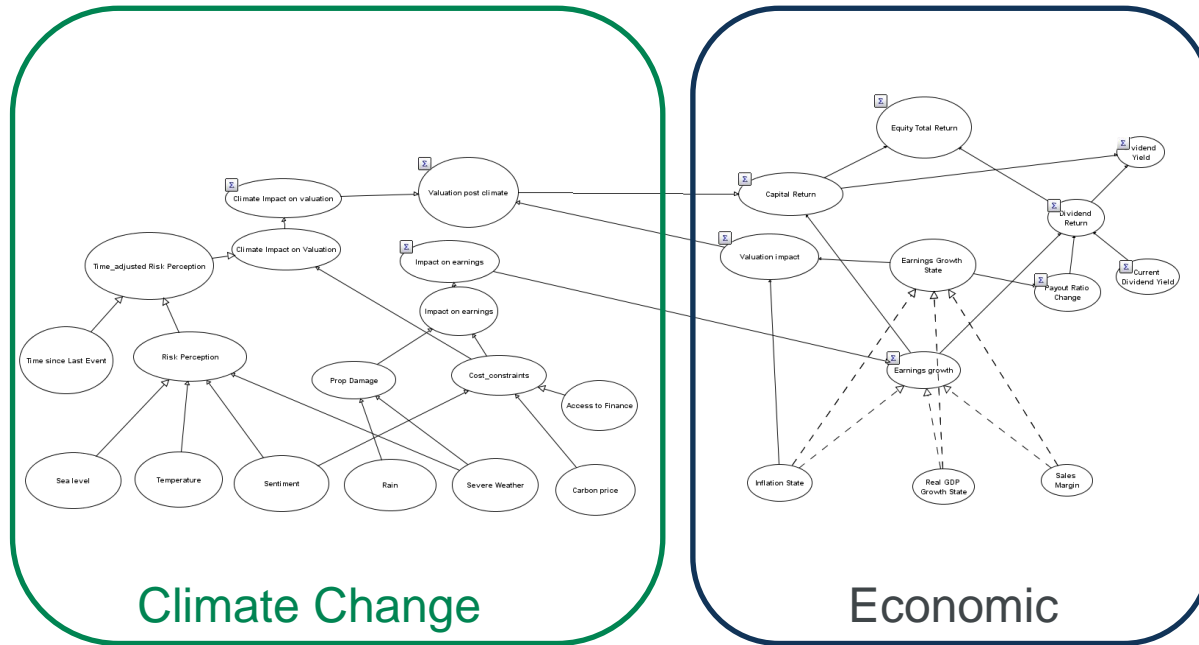
# Case Study



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# Case study: impact on equity returns

## Real Estate sector



### Physical risks:

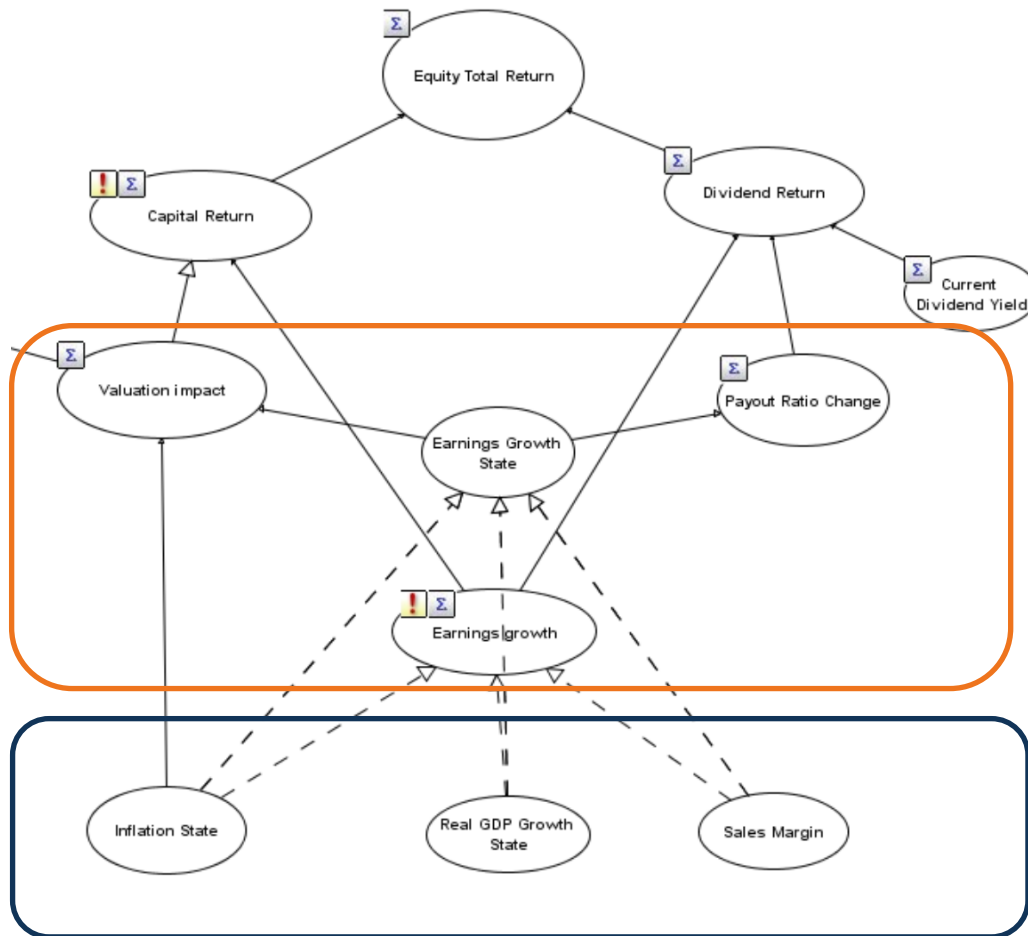
- Chronic change in weather patterns: temperature rise, changes in rainfall, sea level rise
- Severe weather events: storms, floods

### Transitional risks:

- Stranded assets
- Energy efficiency
- Increased cost of regulations

# Case study: impact on equity returns

## Real Estate sector



### Drivers:

- Inflation State
- Real GDP Growth
- Sales Margin

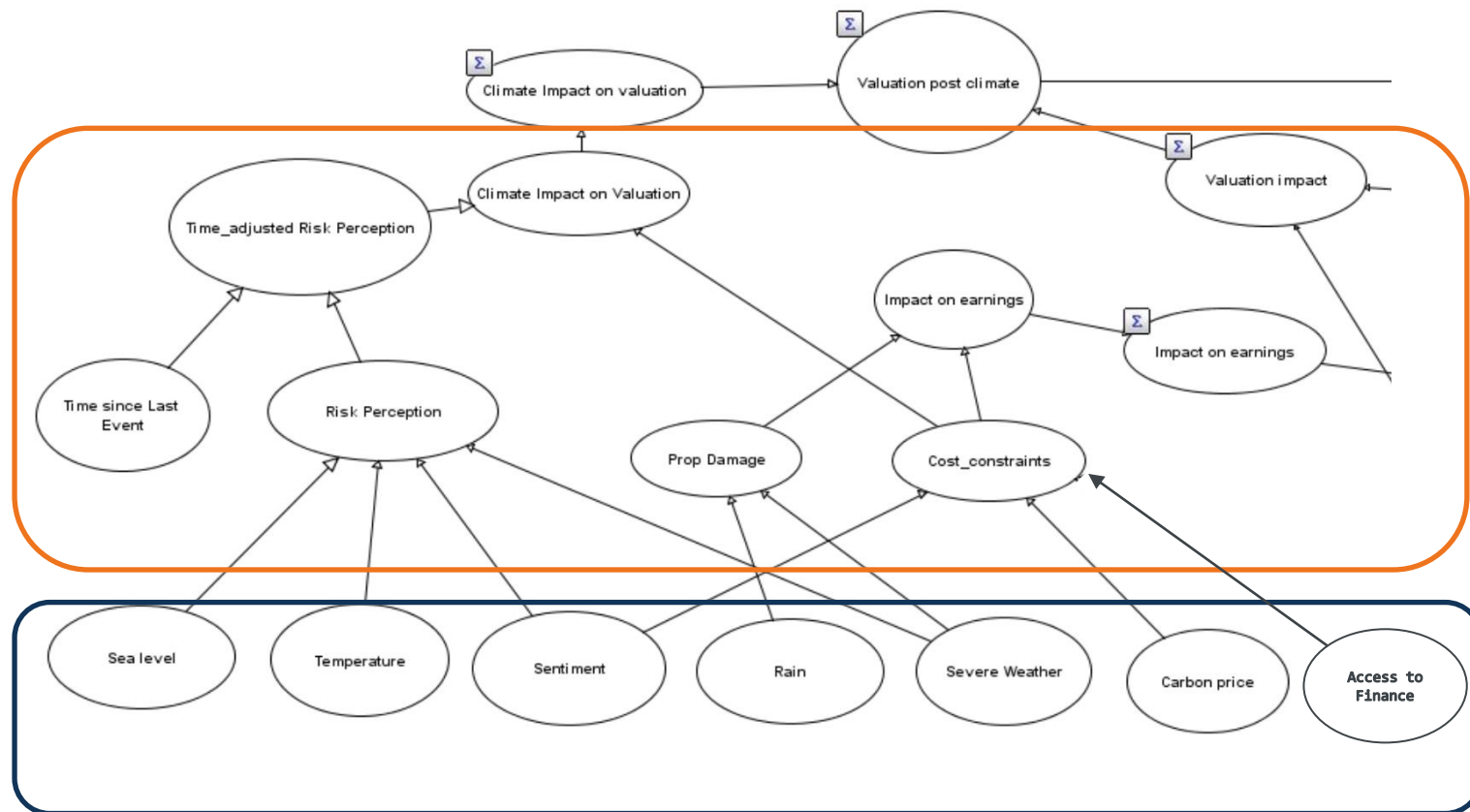
### Nodes:

- Earnings growth
- Valuation Impact
- Payout Ratio Change

$$\begin{aligned} \text{Total Return} &= \\ &\text{Capital Return} \\ &+ \\ &\text{Dividend Return} \end{aligned}$$

# Case study: impact on equity returns

## Real Estate sector



### Drivers:

- Rainfall
- Sea Level
- Severe Weather
- Temperature
- Carbon Price
- Public Sentiment
- Access to finance

### Nodes:

- Risk Perception
- Property Damage
- Costs / Constraints

# Case Study: Calibration

## Climate change drivers

- Data driven calibration is not feasible
- Expert judgement:
  - Workshops with experts
  - Supported by data where available
- Calibration and results (scenarios) are played back to experts / assessed for reasonableness



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# Case study: scenarios

## Scenarios considered to illustrate impact on the equity returns over time



**Early Action:** the transition to a net-zero emissions economy starts in 2021 - carbon taxes and other policies intensify relatively gradually over the scenario horizon. Global carbon dioxide emissions (and all greenhouse gas emissions in the UK) drop to net-zero around 2050.

**Late Action:** the transition is delayed until 2031, at which point there is a sudden increase in the intensity of climate policy. In the UK, greenhouse gas emissions are successfully reduced to net-zero around 2050, but the transition required to achieve that is more abrupt and therefore disorderly.

**No Additional Action:** no new climate policies are introduced beyond those already implemented prior to 2021.



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# Case study: scenarios

Scenarios considered to illustrate impact on the equity returns over time



## Hybrid scenario

**Early Action:** policies are being introduced and the cost of regulation increases – but not a global process

**No Additional Action:** due to non-global spread of policies intended to tackle climate change, climate variables follow the pathway of NAA scenario

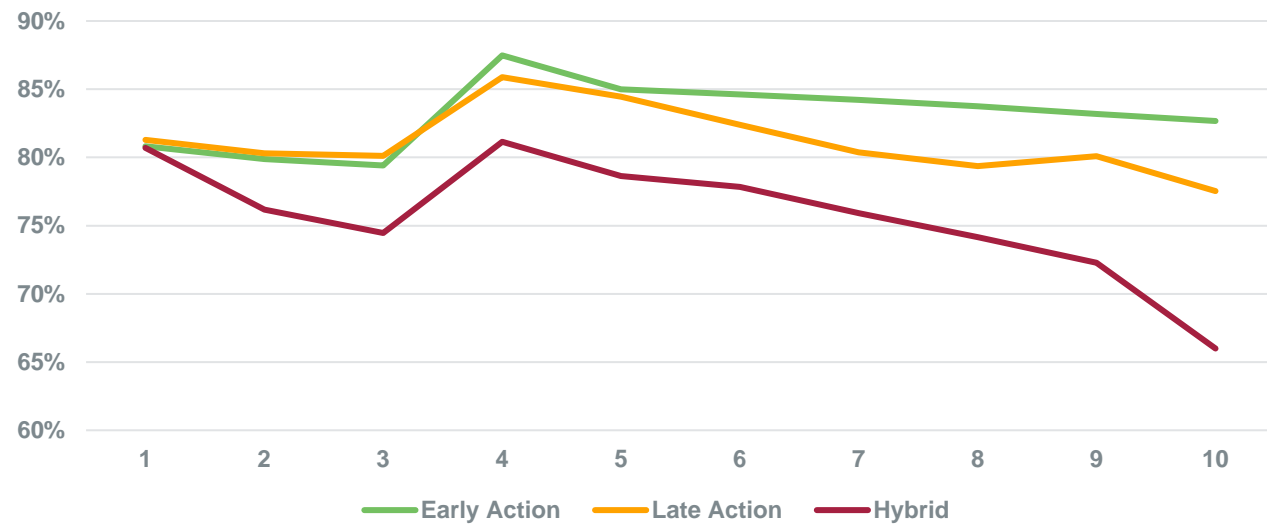


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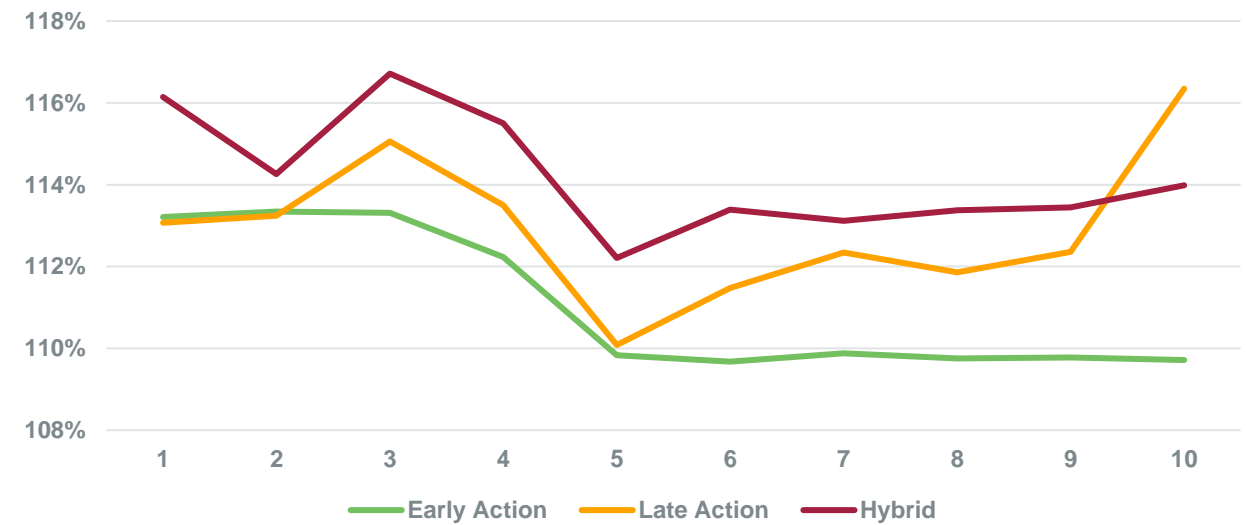
# Case study: results

## Real Estate

Mean Annual Return (% of Base)



Standard Deviation of Annual Return (% of Base SD)



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# Potential model extensions

- Alternative structure: impact of the climate drivers on the margins rather than earnings
- Economic drivers to be impacted by the climate change drivers
- Modelling for other sectors: additional climate drivers, e.g. Agricultural yield for Consumer Staples
- More nuanced modelling, e.g. seasonal impact in change in precipitation

# Questions

# Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenter.



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# Thank you

Adel.Drew@milliman.com

Tatiana.Egoshina@milliman.com

Research Paper

Causal modelling: A possible application considering climate risk and asset returns


<https://www.milliman.com/en/insight/causal-modelling-climate-risk-asset-returns>

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# Appendix

## Summary of PRA's observations of SS3/19 embeddedness

 <b>PRA's observations on firms' progress in responding to SS3/19 as noted in <u>Dear CEO</u> letter dated 21 October 2022</b>			
Section	Overall observations	Effective observation examples	Less effective observation examples
<b>Governance</b>	Firms have made significant progress in embedding supervisory expectations including effective levels of climate governance and appropriate training for key individuals	<b>Business strategies, planning, governance &amp; risk management processes:</b> <ul style="list-style-type: none"> <li>Boards &amp; Execs able to demonstrate how climate considerations impact these areas</li> <li>Coherent approach across these areas</li> <li>Supported by appropriate metrics &amp; risk appetites</li> </ul> <b>Other:</b> <ul style="list-style-type: none"> <li>Climate embedded into remuneration targets</li> <li>Firm-wide training</li> <li>Continual development of climate management information</li> </ul>	
<b>Risk Management</b>	Progress made by firms, but significant variations in maturity observed.  In many cases work is still needed to finalise embedding of climate risk into Risk Management Frameworks, risk appetites and committee structures	<b>Climate risk appropriately factored quantitatively within:</b> <ul style="list-style-type: none"> <li>Well defined risk appetite statements</li> <li>Climate modelling (with utilisation of prudent assumptions and proxies where necessary)</li> <li>Capital allocated for climate risks</li> </ul>	<ul style="list-style-type: none"> <li>Failings in Risk Management Framework &amp; risk appetites impaired the Board &amp; Execs' ability to manage climate risk</li> <li>Lack of climate risk management for u/w practices</li> <li>Lack of view on counter-parties' exposure to climate risk and transition plans</li> <li>Demonstration of adequate capital still maturing</li> </ul>
<b>Scenario Analysis</b>	In general, scenario analysis capabilities not developed enough to support effective decision-making  Use of climate risk models supported by limited information on how gaps in data & methodologies would be addressed	<b>Use of modelled results accounts for uncertainties via:</b> <ul style="list-style-type: none"> <li>Prudent assumptions</li> <li>Manual adjustments</li> <li>Sensitivity analysis</li> <li>Identifying and addressing limitations of third-party models</li> </ul>	<ul style="list-style-type: none"> <li>Inability to articulate objectives for which scenarios had been defined &amp;, therefore, how chosen approach meets objectives</li> <li>Unclear how scenario analysis was used to inform Own Risk Solvency Assessments and risk appetite metrics</li> <li>Lack of internal consistency within scenarios &amp; relevance to firms' specific vulnerabilities</li> <li>More progress needed on embedding physical risks into corporate modelling</li> </ul>
<b>Disclosure</b>	All firms need to continue to evolve their disclosures as they develop their understanding of the climate risks relevant to them  In general firms using Annual Reports, or a standalone climate report, for disclosures	Effective use of disclosures demonstrate consistency across financial reports, standalone climate disclosures, Pillar 3 & Solvency & Financial Condition Report	Limited disclosures with little/no contextual information to support climate disclosures, or lack thereof
<b>Data</b> (as relevant to all four areas of SS3/19)	Observed that all firms are in need of more robust, standardised climate-related data of sufficient coverage	<b>Interim measures to address gaps:</b> <ul style="list-style-type: none"> <li>Data gaps identified &amp; strategies employed</li> <li>Use of assumptions &amp; proxies documented &amp; disclosed</li> </ul>	

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