

# Choice under risk

a demonstrational experiment

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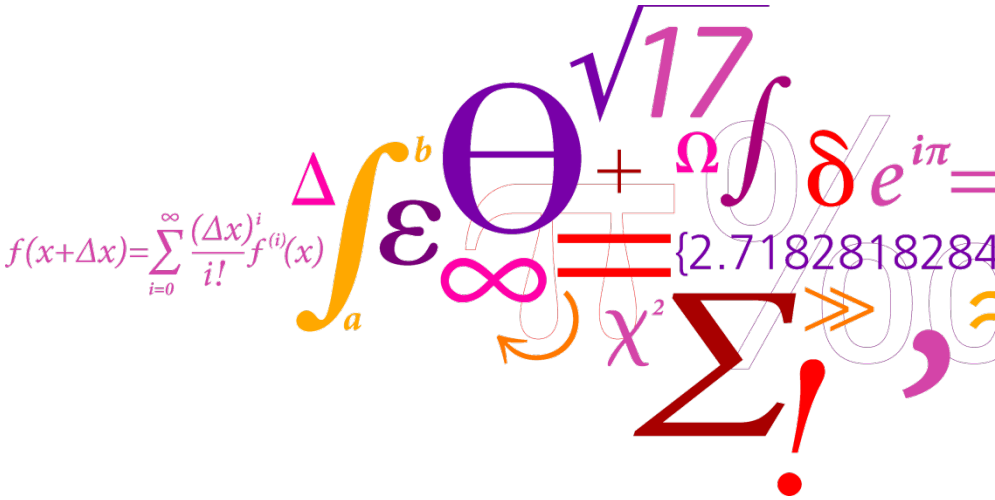
# Choice under risk

## a demonstrational experiment





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Department of Management Engineering

# Adaptation choices

"The inclusion of research from behavioral economics and science is most certainly warranted and is an improvement from AR4."

"Acknowledging the importance of behavioral economics for explaining how different agents make decisions under uncertainty is important to understanding the effects of policy and in turn optimal (or at least better) policy design at any level of decision making."

"Behavioral research has an important role … when they pertain to decision making under risk and uncertainty"

"In adaptation choices it is important to consider the differences between the potential of adaptation and its achievement as a function of various factors, such as costs, barriers, available resources and behavioral biases"

[Expert and Government Review Comments on the IPCC AR5]

# Choice under risk and uncertainty

- How people make decisions involving risk and uncertainty and how economists think people *should* make these decisions often differ
- It is important to acknowledge how we *really* make decisions
- Cognitive **biases** in choice arise because we use simple **heuristics** that are often useful but sometimes lead us astray
- There are complex interdependencies among nations, companies and individuals all over the world via issues of inequity aversion, coordination failure and similar "**other-regarding preferences**"

# Choice under risk and uncertainty

- Heuristics are convenient, but sometimes, particularly in the context of extreme weather events, they can lead to disastrous systematic errors

- It is possible to do something about it:

  First, **understanding** the pitfalls in decision making, **testing** them, and **learning** to avoid them. Then, with the acquired knowledge, it becomes feasible to make, and **advise** on how to make, **better decisions**

- …so, how can we **test** whether people's choices systematically deviate from what is predicted by classic economic models?

# Economic experiment

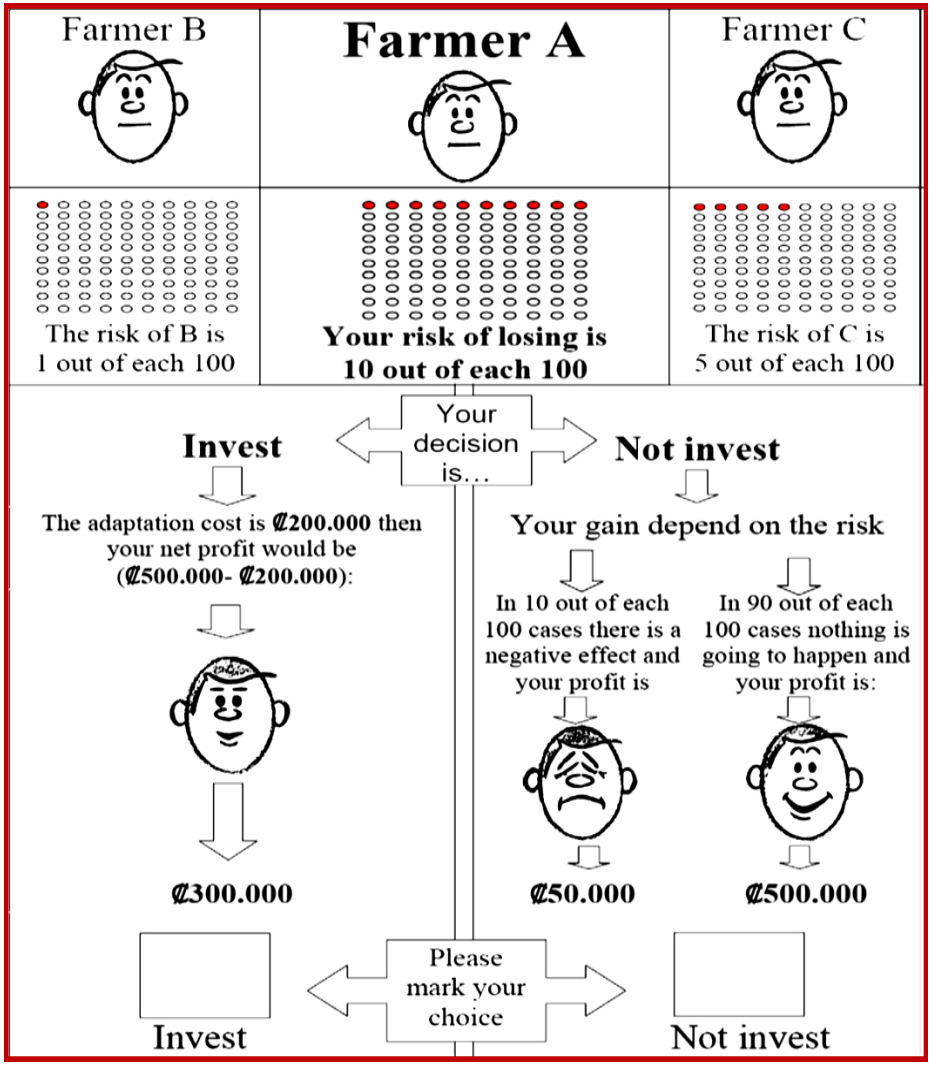
- Like with most experiments you have a control and tested group, or a baseline treatment and the tested treatments
- In an economic experiment, we observe the behavior of **real** people
- the people are motivated by **real economic incentives**
- their behavior is observed under **controlled conditions**

# Field framed experiment

- Conducted with Costa Rican coffee bean farmers just after the Alma tropical storm

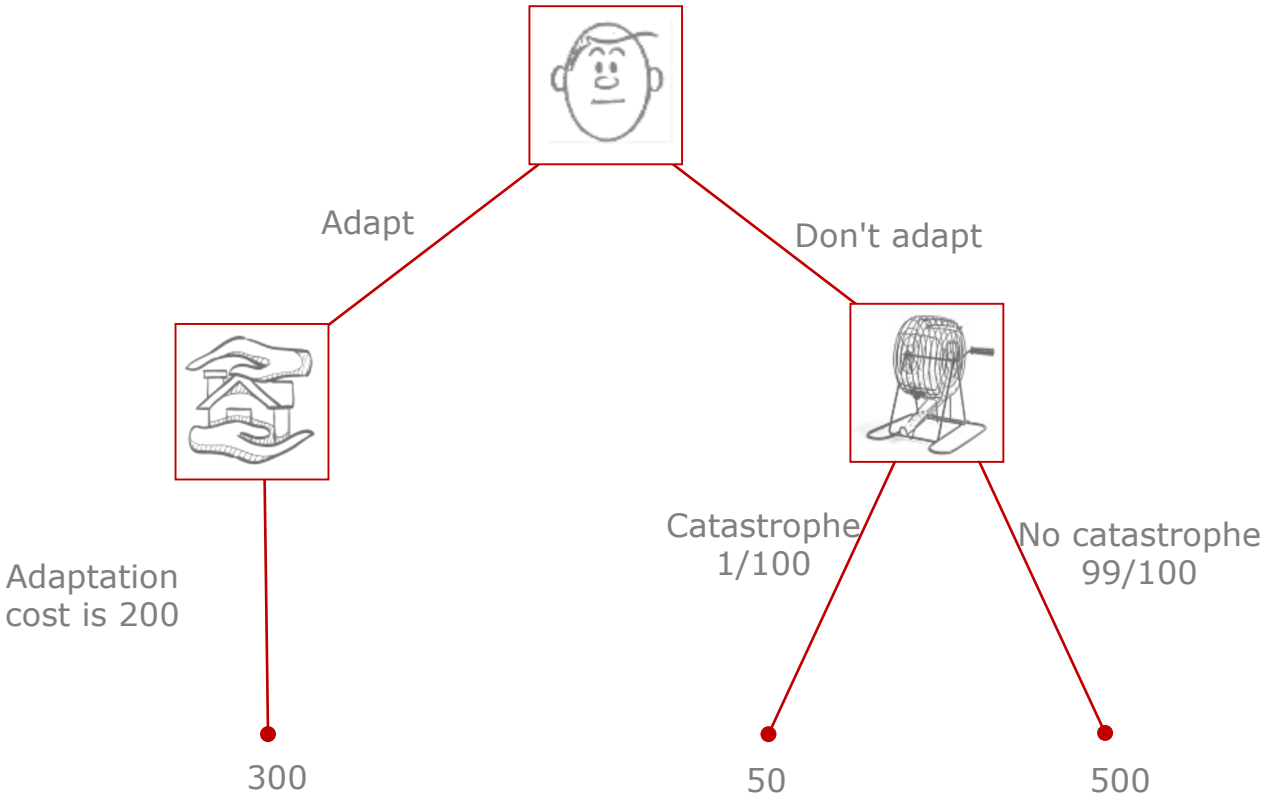
- 12% of coffee bean plants were destroyed

- amounting to a loss of 20 billion colones ≈ 200 million DDK



# Risk attitude

Risk experiment – a baseline exposing the farmer to various risk levels, based on real life calibrations, i.e. 1/100, 5/100 **and** 10/100




- Prediction: share of farmers adapting rises as the level of risk increases to 10 pct

# Findings from Alpizar et al.

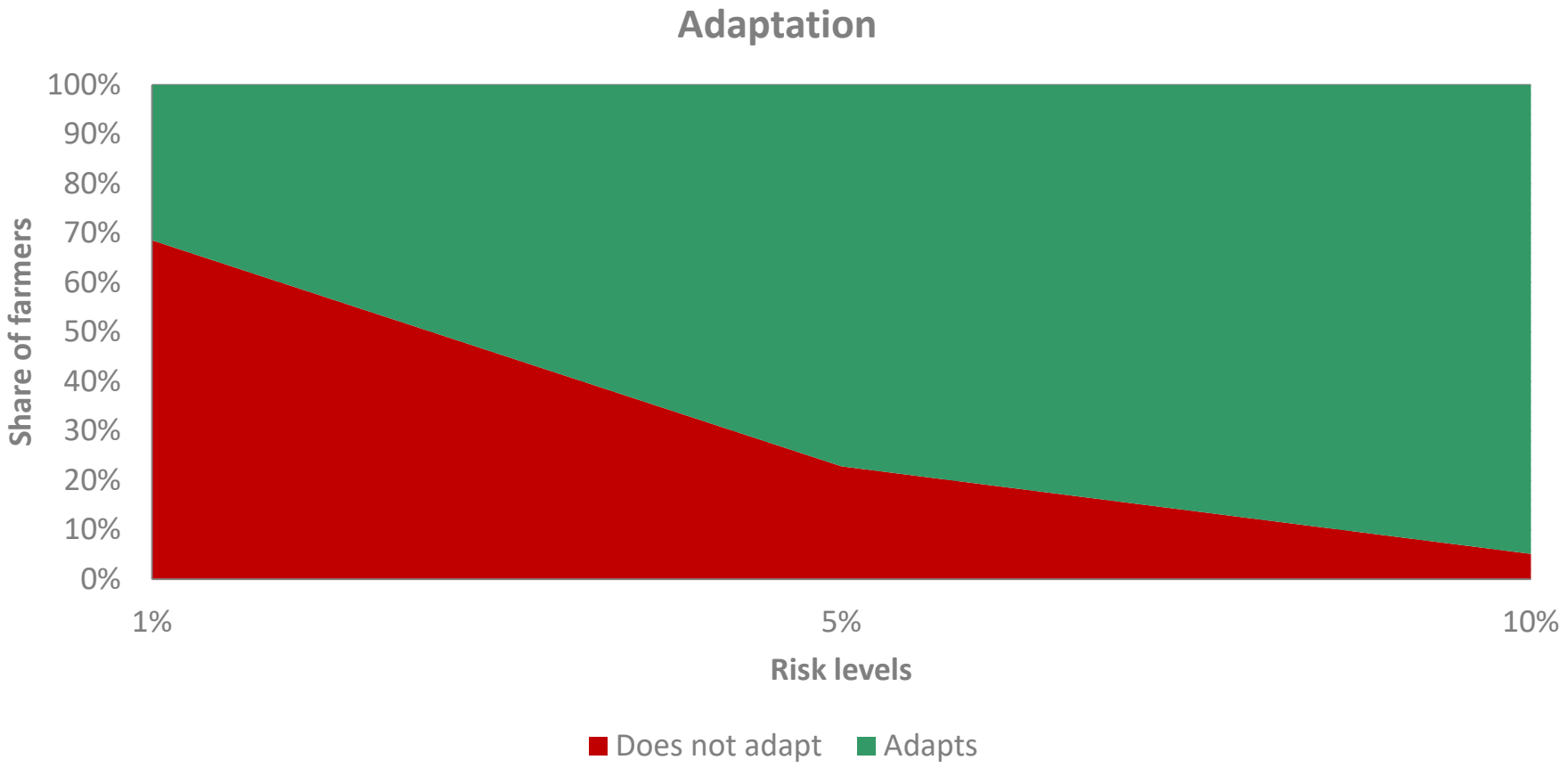
**TABLE I**

Number of participants not adapting and adapting under various levels of risk

| Risk levels | Does not adapt | Adapts |
|---|---|---|
| 1% | 120 (69%) | 55 (31%) |
| 5% | 40 (23%) | 135 (77%) |
| 10% | 9 (5%) | 166 (95%) |

Table I presents the number and share of farmers adapting and not adapting at three different levels of risks

# Findings from Alpizar et al.




The share of farmers adapting increase as the level of risk

# Results

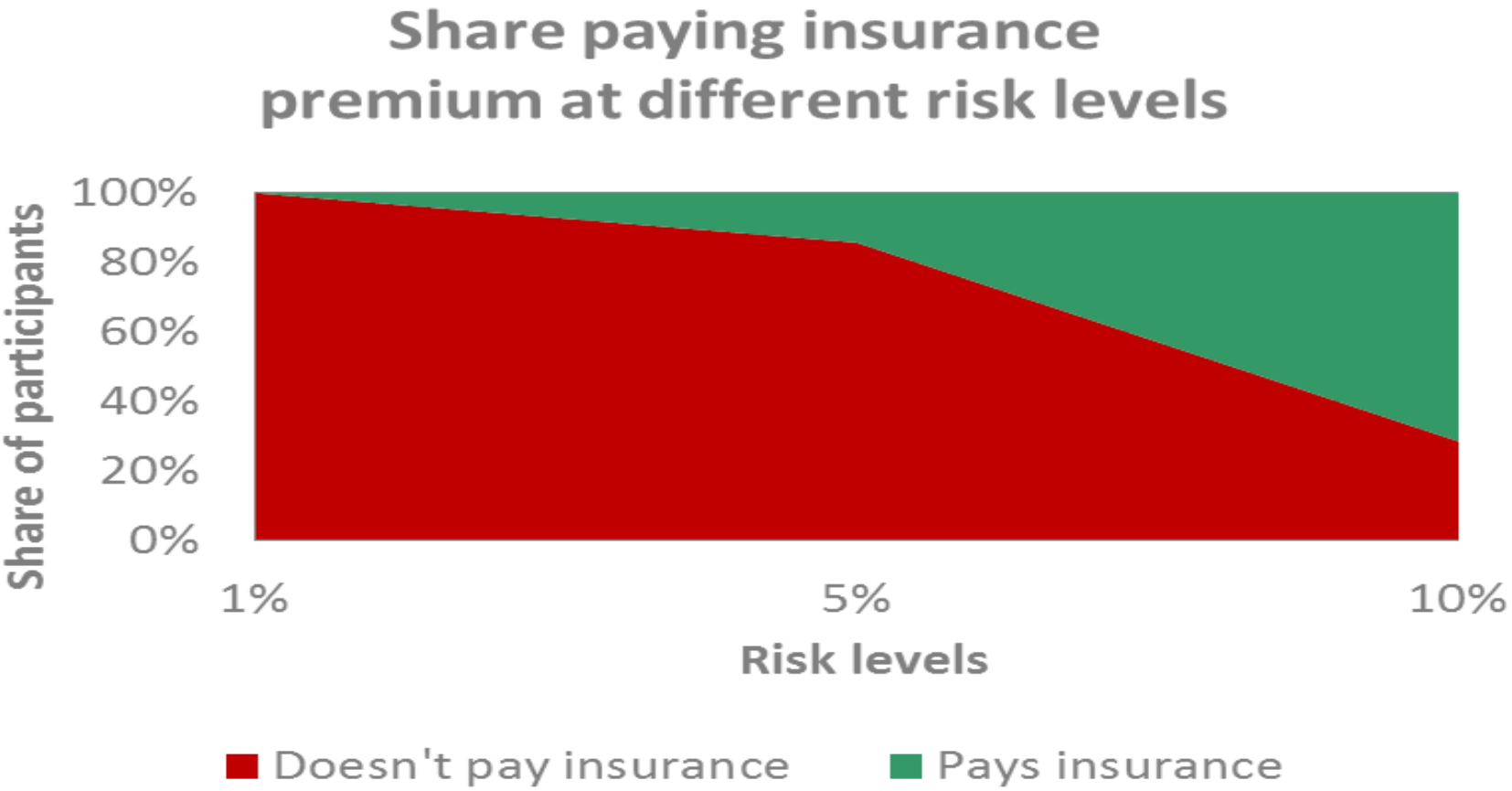
**TABLE II**

Number of participants not paying and paying an insurance premium under various levels of risk

| Risk levels | Doesn't pay insurance | Pays insurance |
|---|---|---|
| 1% | 7 | 0 |
| 5% | 6 | 1 |
| 10% | 2 | 5 |

As expected, the share of participants increase as the level of risk increases

# Results




The share of participants paying an insurance premium increase as the level of risk increases

# What can these findings be used for?

- Many behavioral anomalies are related to risk attitude
- Using the risk attitude experiment as a baseline treatment, it is possible to test behavioural biases that stem from risk attitudes
- For example, Alpizar *et al.* found that:
- Ambiguity aversion – unknown risk increases adaptation
- Coordination failure – coordinate decisions to secure a lower adaptation cost, and communication strongly facilitated coordination

# …so what?

- Recognizing and understanding behavioral biases provides an entry point for designing strategies that can improve individuals' adaptation decisions
- Once tested, it is possible to examine ways in which these biases can be taken into account, as well as which tools to apply
- According to the latest IPCC report, policies that consider factors such as risk perceptions and behavioral biases increase their efficiency

Thank you

# Risk attitude example

- Suppose a friend offers you the following. He flips a coin.
  If heads, you get €1,000
  If tails, you pay him €1,000

- risk averse: pain of loosing €1,000 > joy of winning €1,000

- As wealth increases
  the utility fct flattens

What are (potential) implications?
→loss aversion
→miscalculate probabilities

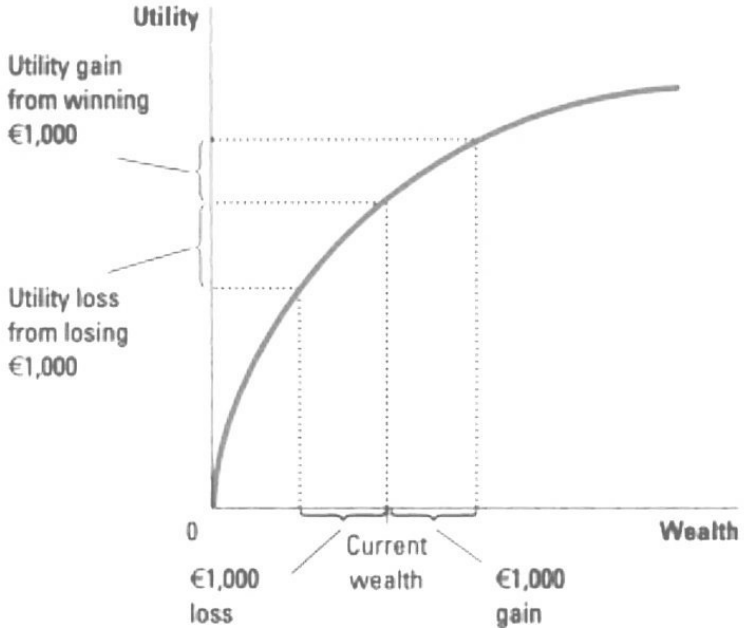



***Figure 2*** *Utility function – risk averse* [Mankiw 2011]

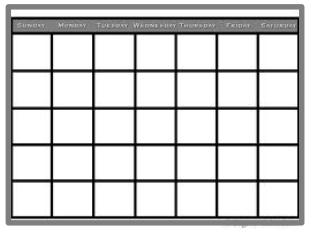
# Ambiguity aversion

- What is ambiguity aversion?

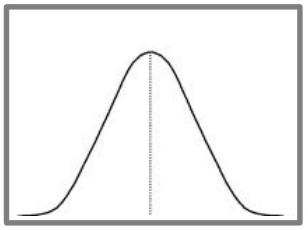
→ a dislike of gaps and inconsistencies in information regarding probabilities or outcomes

- In a decision context, ambiguity can be present in 3 ways:

Unknown timing



Unknown probabilities



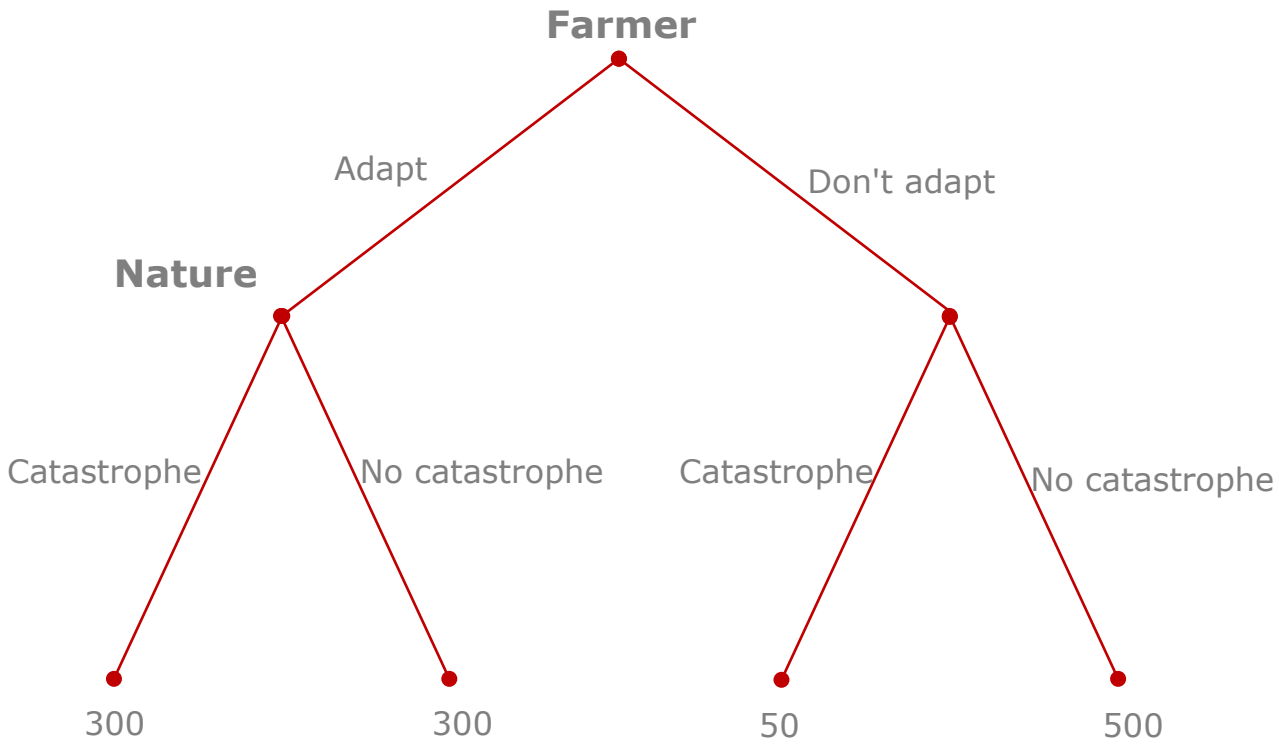
Unknown stakes


- Daniel Ellsberg demonstrated aversion to the second type of ambiguity with his infamous experiment, the results of which have become known as the Ellsberg paradox because they are inconsistent with the predictions of expected utility theory

[Öncüler 2010]

# Ambiguity aversion

Unknown risk and ambiguity aversion - farmer does not know risk levels, i.e. 1/100, 5/100 **or**10/100 - expected risk is 5.3 percent




- Prediction: adaptation is chosen more often under uncertainty than with known risks - the ones who do not adapt at 5 pct but do at 10 pct would adapt in the ambiguous situation.

# Typology of risk

- What are virgin risks?

→ those that we have neither experienced nor contemplated

- What are experienced risks?

→ those that we think about and have experienced before

| | **Out of mind** | **Recognized** |
|---|---|---|
| ***No occurrences*** | Virgin risks | Contemplated risks |
| ***Past occurrences*** | Neglected risks | Experienced risks |

- What are (potential) implications?

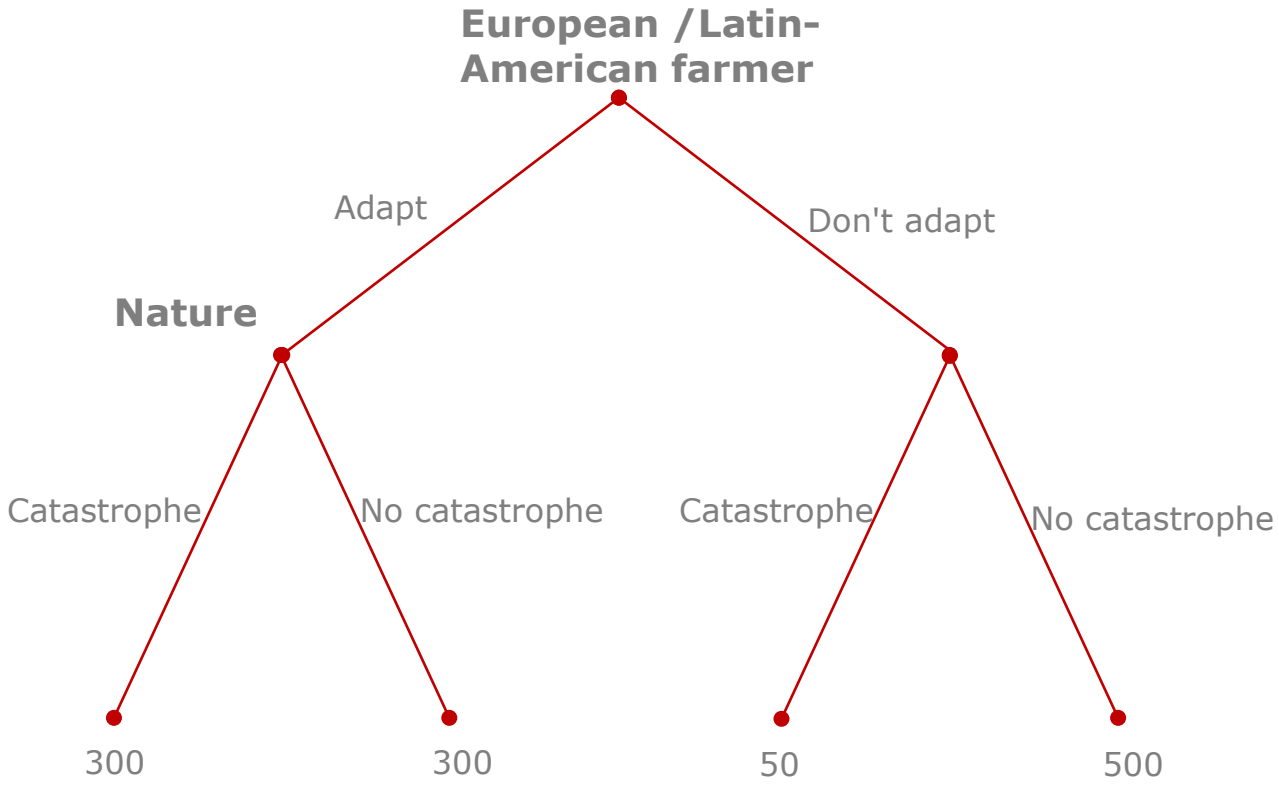
→ after a virgin risk one overestimates the prob of another occurrence

→after an experienced risk one under-updates this prob

[Kousky *et al* 2010]

# Over- underestimating probabilities

Various classes of risk: farmer does not know risk levels, i.e. 1/100, 5/100 **or**10/100 - expected risk is 5.3 percent. The experiment is conducted in Europe (virgin risk) and in Latin-America (experienced risk).




- Prediction: adaptation is chosen more often in the experiment conducted in Europe – people will overestimate the probability of a catastrophe occurring in the near future.

# Probability weighting

- Decision weights overweight low probabilities and underweight high probabilities
- The sensitivity to changes in probability decreases as probability moves away from the reference point of 0 or 1


Most are willing to pay more to remove one bullet from a Russian roulette when it is the only bullet than if there are two or more bullets

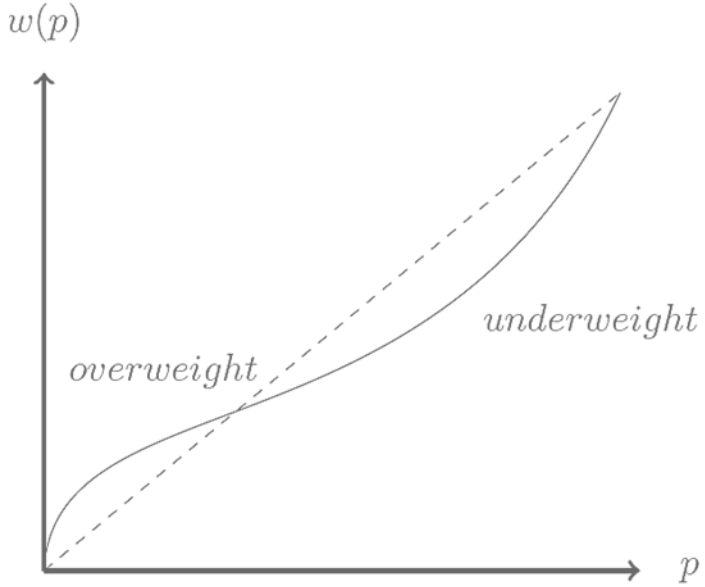



***Figure 4*** Weighting function

# Loss aversion

- What is loss aversion?

→ a preference for avoiding losses rather than acquiring gains

- Risky prospects are not evaluated in terms of outcomes but in terms of **changes** w.r.t. to reference point

- Losses weigh more heavily than gains of equal size (kink at the reference point): **loss aversion**

- Concave in gains but convex in losses → risk aversion in gains but **risk loving in losses**

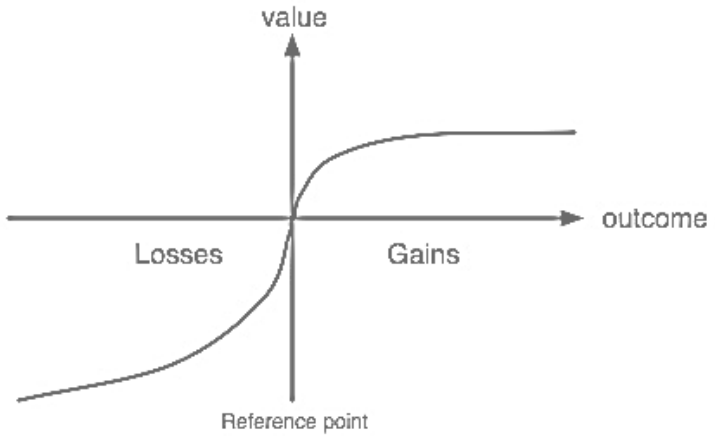


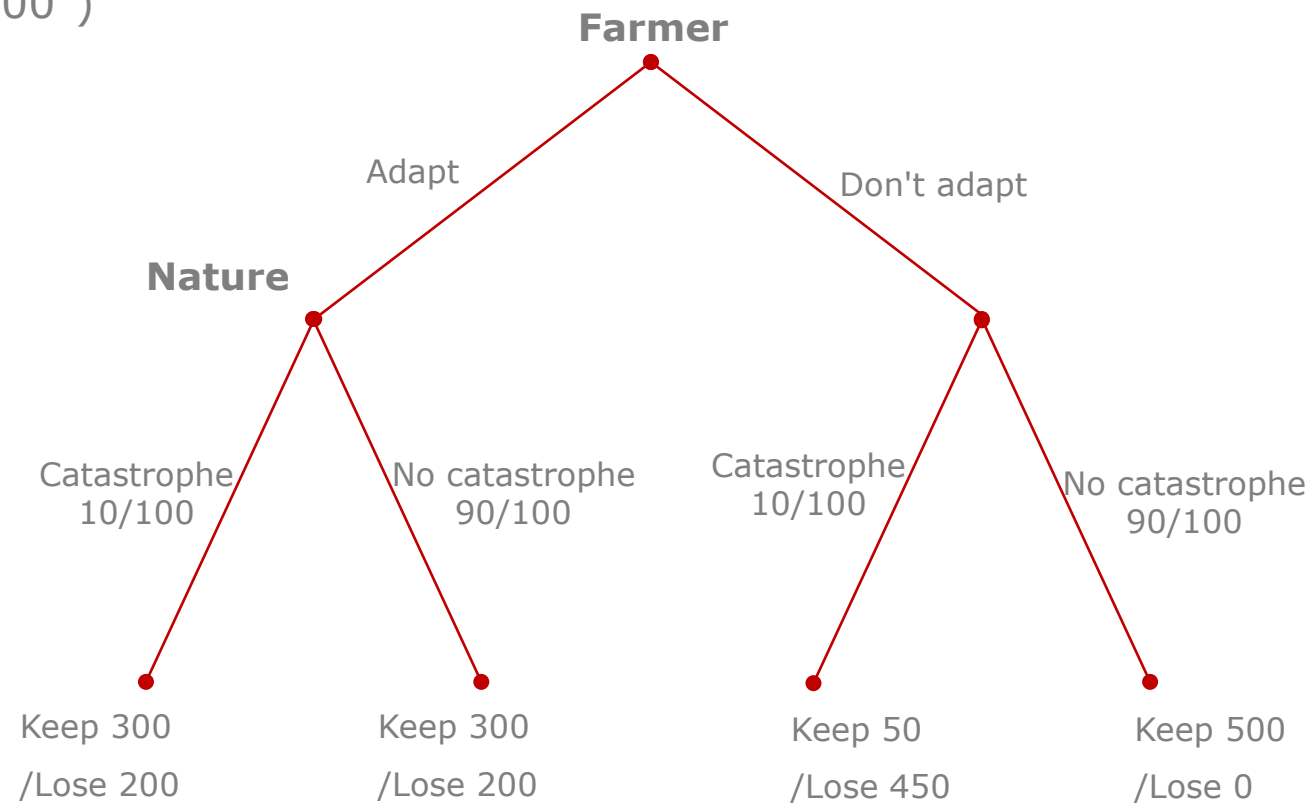

*Fig. 2: Utility function in prospect theory*

[Tyran 2009]

- What are (potential) implications? Endowment effect, status quo bias, …

# Loss aversion

Farmers are endowed with 500 and make choices between a "sure" option and a gamble. There are two frames: either a gain ("keep 300") or a loss ("lose 200")




- Prediction: gamble is chosen more often in the "loss" frame - risk averse (loving) in gain (loss)

# Coordination failure

- What is coordination?

inability to coordinate their choices leads to an outcome that leaves all worse off than in an alternative situation that is also an equilibrium

- The farmers' choices for adaptation investment in this case are said to be complements

- The way a farmer reacts to others' choices is depicted by the curved line. It reflects the fact that if all farmers don't adapt, the remaining farmer will find it optimal to not adapt either

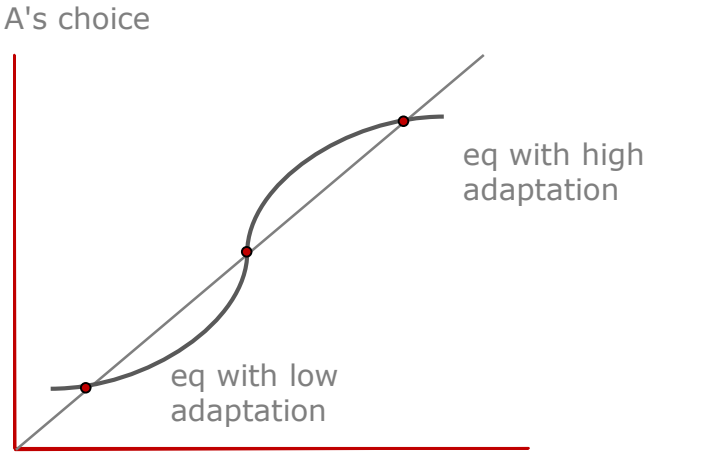



*Fig. 3: Multiple equilibria*

- What are (potential) implications?

Given a non-adaptation status quo, this equilibrium is likely to prevail

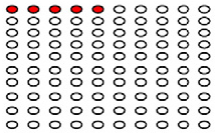
[Tyran 2009]

# Coordination

- A basic problem of economics

| **No catastrophe** | | Farmer B and C | |
|---|---|---|---|
| | | adapt | don't adapt |
| Farmer A | adapt | 400, 400 | 300, 500 |
| | don't adapt | 500, 300 | 500, 500 |

tombola



| **Catastrophe** | | Farmer B and C | |
|---|---|---|---|
| | | adapt | don't adapt |
| Farmer A | adapt | 400, 400 | 300, 50 |
| | don't adapt | 50, 300 | 50, 50 |

Predictions: Equilibria may be rankable, but it still does not guarantee that people will actually end up in the "better" equilibrium. Instead, status quo may prevail due to switching costs – unless for example communication is introduced.