# Quantifying economic value of meteorological services: some general concepts and applications

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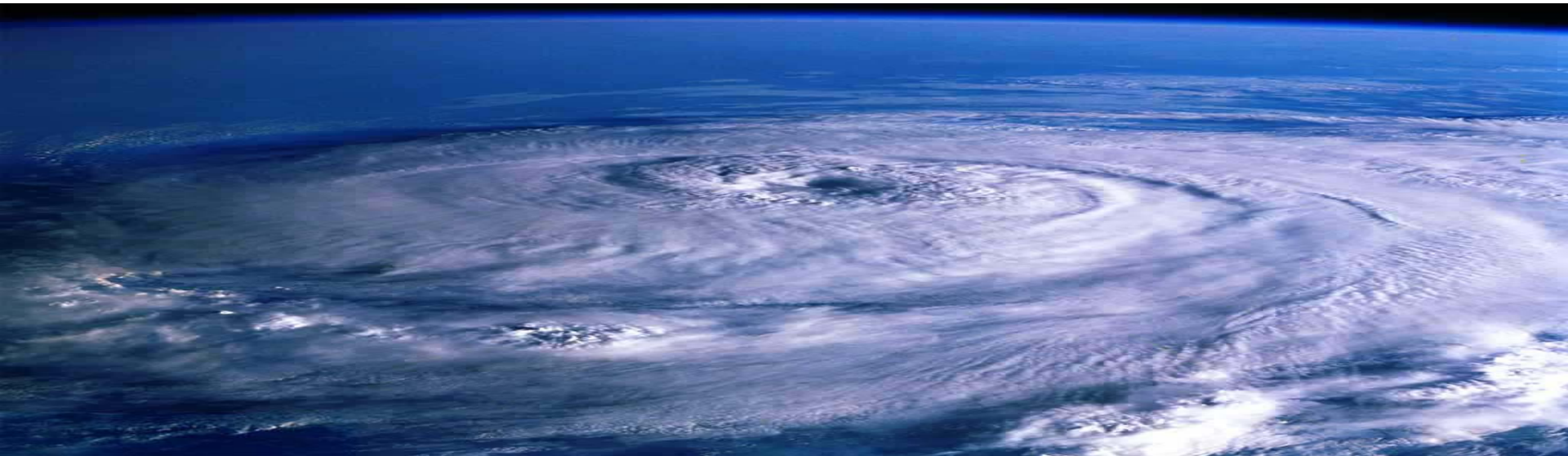
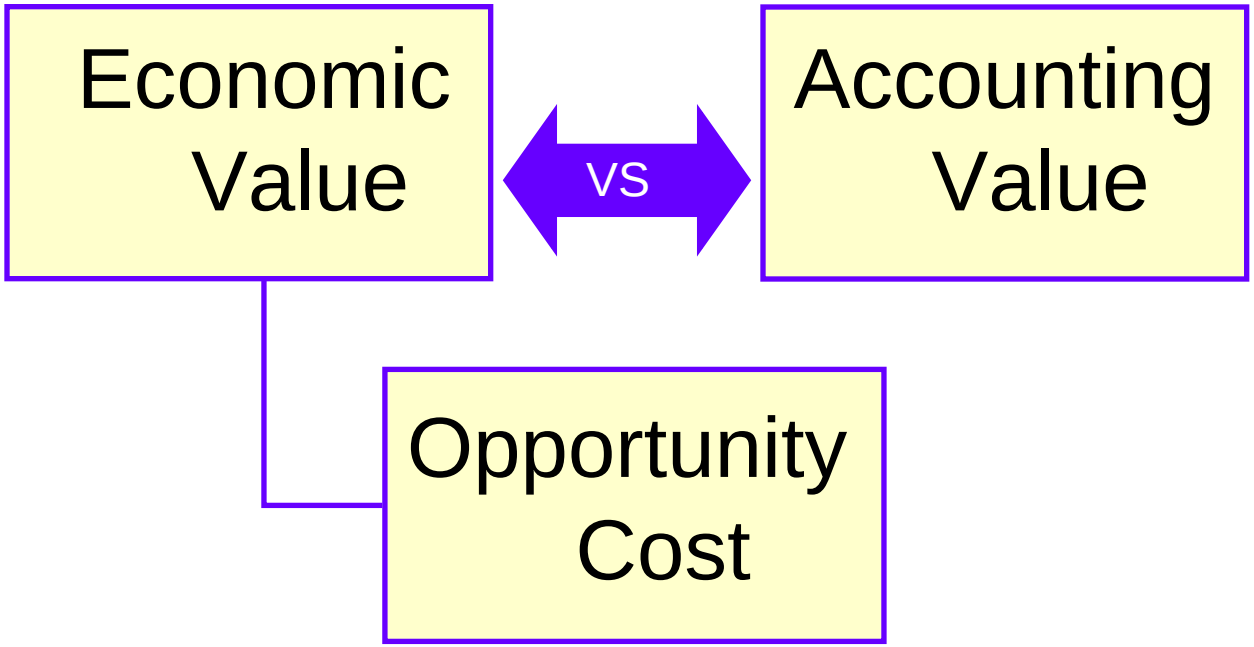
*The economic value of the information is derived on the decisions we make. ¿What is a good prediction?*

*The best information is at risk of being worthless if it is not communicated in a manner that is meaningful, actionable and understandable*



Why is so important the economic valuation of the meteorological services?




**As weather information is a semi-public good, usually economic value can't be observed as a market value**

# Quantifying the socio-economic benefits

- *Who is the decision-maker?*
- *Does the meteorological information affect his decisions? At which step?*

**Sensitivity to weather ≠ Sensitivity to weather information**

- *Steps in an information system (Lazo, 2008):*
  - *Climate/Meteorology*
  - *Observation*
  - *Forecast*
  - *Comunication*
  - *Perception*
  - *Use*
  - *Economic Value*

# Information Value: concept

Meteorological information value is derived of the effects that this information has on individual decisions linked to any activity that is dependent of climate conditions

What is different in each case study is the methodology used to quantify this value, but as general approach we consider:

IV= EV (with information)-EV (without information)
where IV: information value and EV: expected value

*"If the information does not change the decision-making process, it has no socio-economic value"*

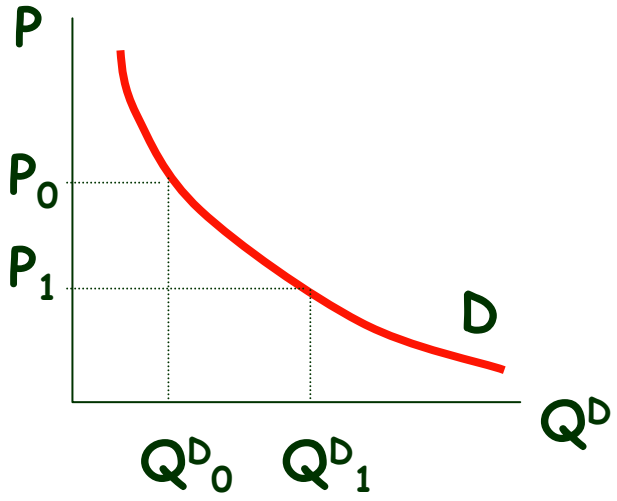
# Some quantitative methods include:

- **Direct methods:**
  - *Estimation of demand relationships*
  - *Surveys (contingency valuation)*
  - *Decision-making models (cost-loss ratio situation, umbrella problem)*
- **Indirect methods:**
  - *Hedonic prices*
  - *Econometric models to identify different sectors sensitivity to the climate conditions*

# Estimation of demand relationships

Consider the relationship between the quantity of some good that consumers are willing to buy and the price that consumers are willing to pay for it

$Q^D$ is the demanded quantity
P is the unitary price




PROBLEM:

Basic meteorological services constitute what in economy we understand as **PUBLIC GOODS** (no rivality, no exclusivity), so this is just useful for some special services counting with market prices

# *Surveys (contingency valuation)*

- *Surveys to stakeholders*
  - *To estimate stakeholders valuation as a function of their characteristics and their reveled preferences*
- *Econometric models for discrete choice (Probit, Logit models)*
  - *Would you take into account the information we provide in order to planify your activity? YES/NO*
  - *Could you evaluate (from 1 to 4) the information system we provide to you? 4 being very important and 1 not important at all for my activity*

# *Decision-making models (cost-loss ratio situation, umbrella problem)*

- Uncertainty comes from some meteorological variable producing uncertain events.
- Weather forecasts help to decision making through the revisions on the probability that people associate to this events.
- The economic value of the information system is considered as the difference between the expected benefit when the information is available and the benefit when the information is not available.

# *Model: cost-loss ratio situation*

***Example: A farmer who have to take a decision about the protection of the harvest from an adverse climatological event***

- The most important aspects are:
  - Actions that are available for the agent
  - States of Nature that are possible
  - Probabilities associated to these states of nature
  - Knowledge about the consequences of each par action-state of nature

# *Model: cost-loss ratio situation*

(Thompson, 1952, 1962; Thompson and Brier, 1955; Murphy, 1977)

| Action | Status of nature | |
|---|---|---|
| | Adverse weather | Non adverse weather |
| Protect | *C* | *C* |
| Not to protect | *L* | 0 |

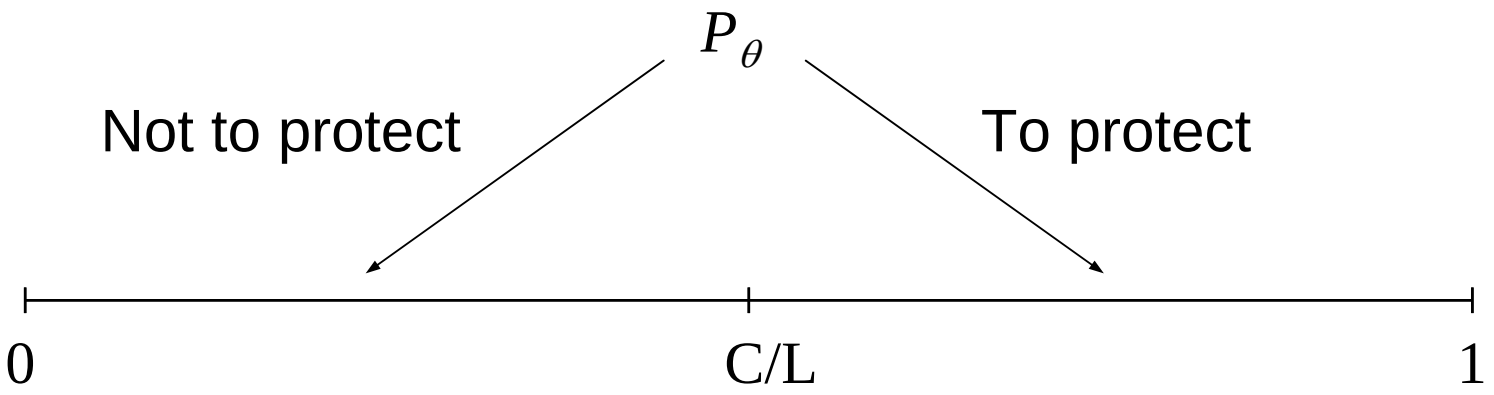
-Protect: EV= P. C + (1-P).C=C

-Not to protect: EV= P.L+(1-P).0=P.L

-P: probability of “bad weather”

# *Model: cost-loss ratio situation*

Decision: Protect if C/L < P




-Meteorological information:

Modify probability / modify the optimal decision

The new probability depends on the quality of the information

# *Model: cost-loss ratio situation under uncertainty*

- Results highly depend on agents behaviour with respect risk:
  - Adverse to the risk
  - Neutral to the risk
  - Propense to the risk

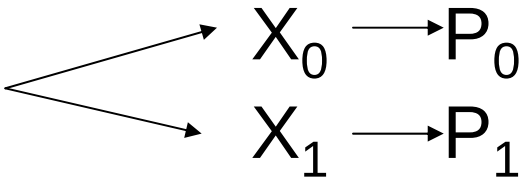
- Most of the studies consider that agents are neutral to the risk, BUT there are evidences of risk aversion under most of the situations

# Methods to deal with uncertainty

- Expected utility models
- Sensitivity analysis
- Evaluation of different options (Scenarios)

# *Uncertainty: Expected utility*

- 2 possible results with different probabilities:



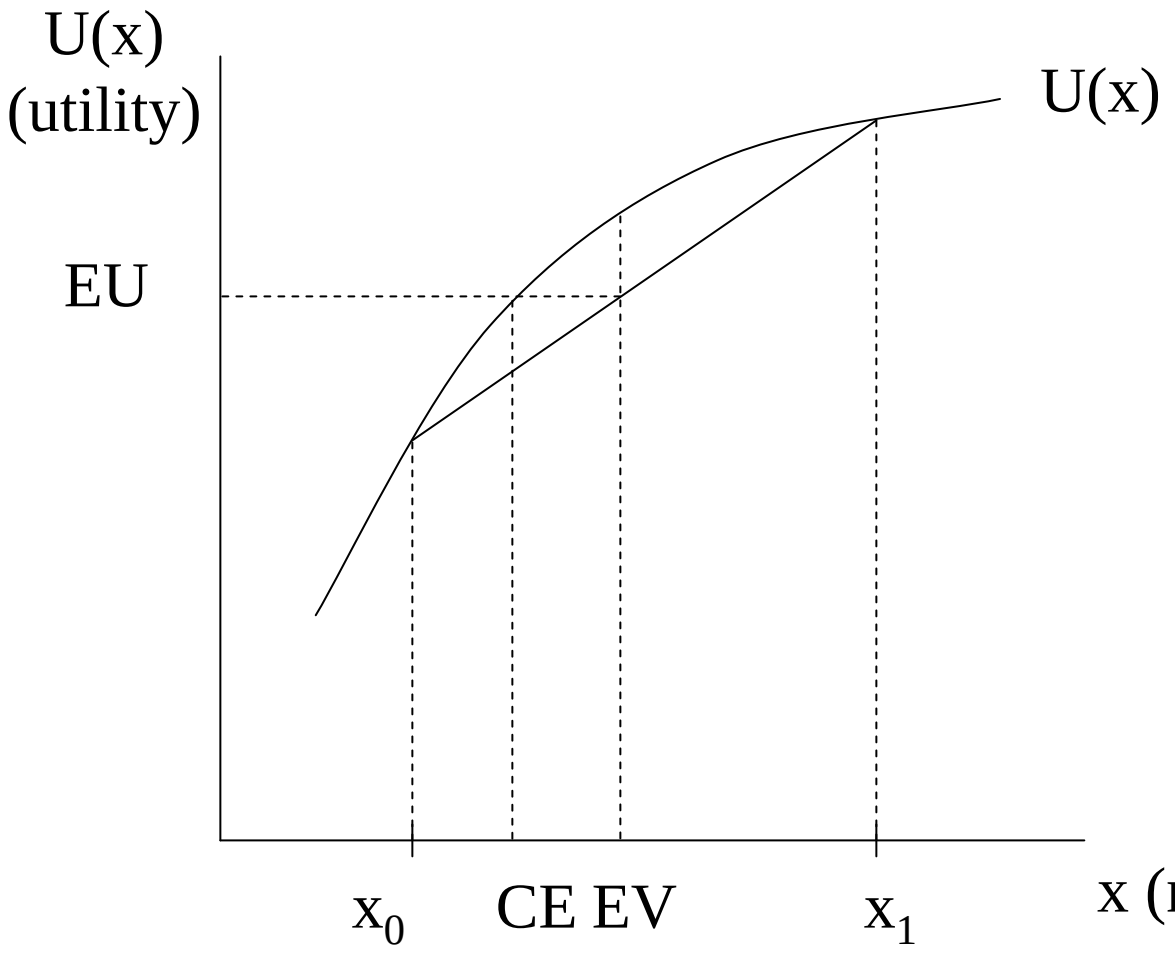

- Expected value:

$$EV=P_0.X_0+P_1.X_1$$

- Expected utility:

$$EU=P_0.U(X_0)+P_1.(X_1)$$

# *Uncertainty: Expected utility*



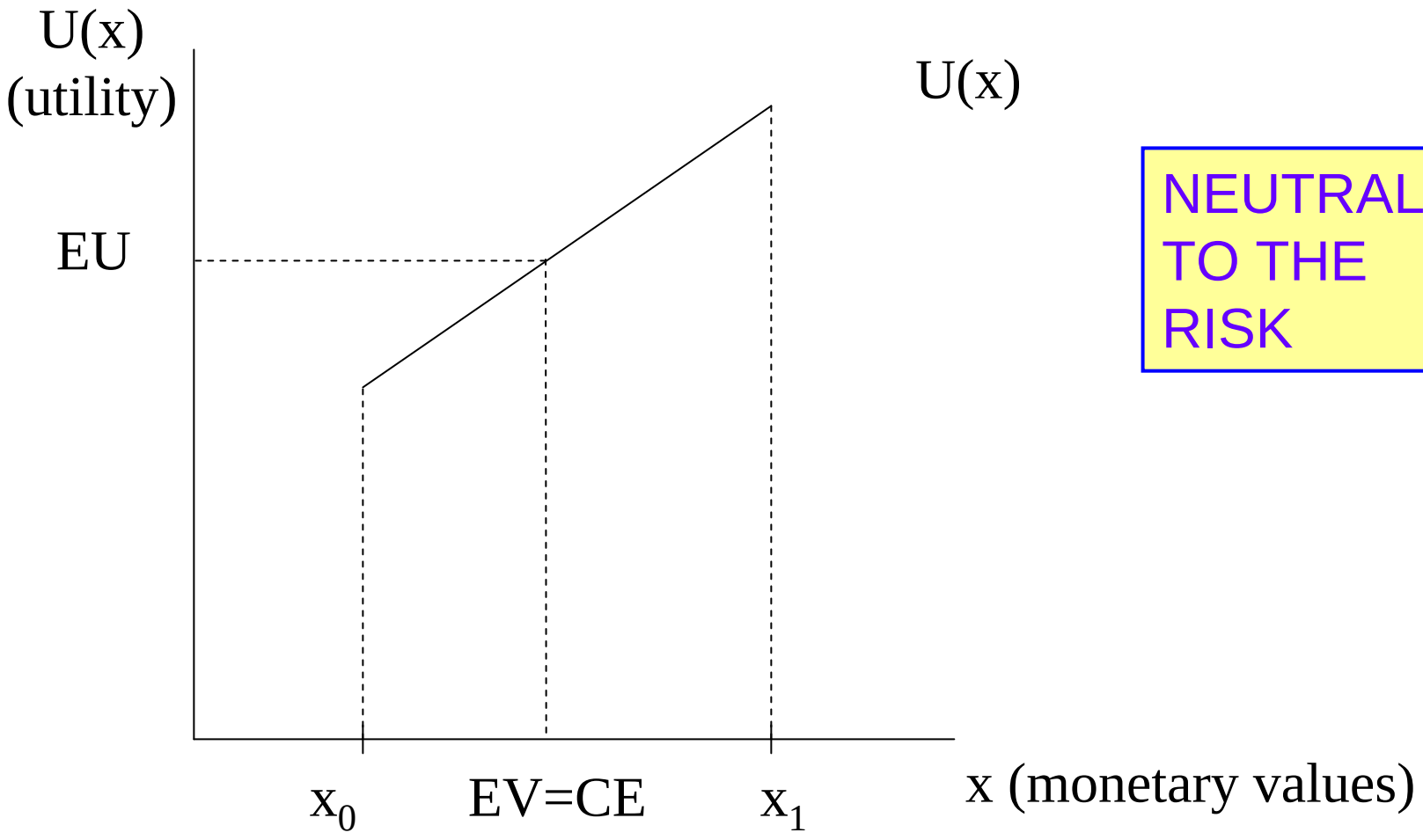

ADVERSE TO THE RISK

# *Uncertainty: Expected utility*

- The certain equivalent (CE) can be defined as the amount of money producing the same utility without uncertainty as the expected utility of a gamble when the risk exists:

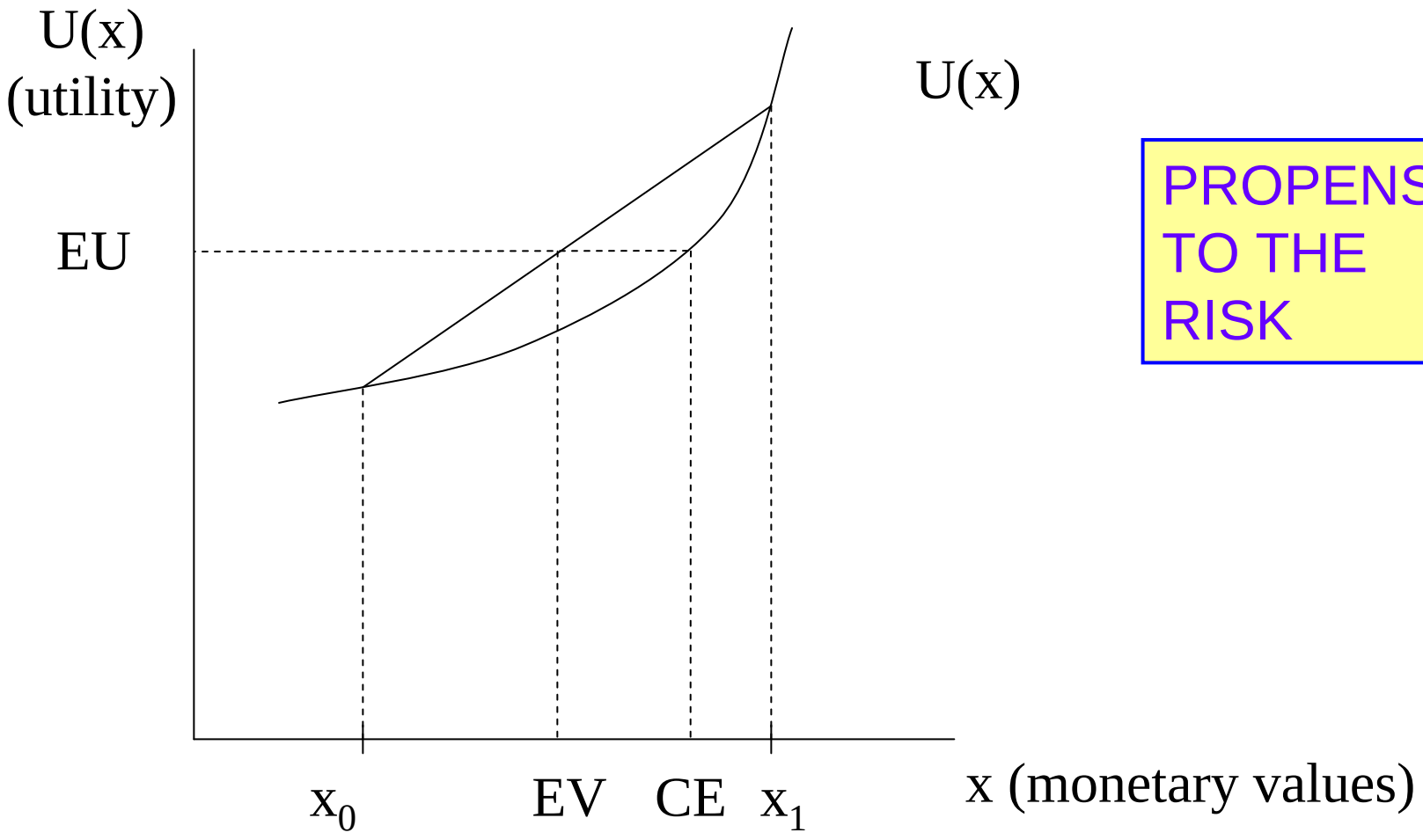
  U(Certain Equivalent)=Expected utility

# *Uncertainty: Expected utility*




NEUTRAL TO THE RISK

# *Uncertainty: Expected utility*




PROPENSE TO THE RISK

# *Hedonic Prices*

- For some services, the economic value can be considered a function of the value of some properties
- Example: environmental damages on an area (such as urban pollution) can reduce prices of houses in that area
- Price elasticity with respect to the information we want to evaluate can be estimated

# *Econometric models to identify the effects of climate on the different economic sectors*

- This models are not directly reporting the economic value for the meteorological information.
- However, it is important to determine the limits of this value
- They can help to see how the economic results depend on climate, so this is the upper limit of the information value.
- That is, if the information is improved, and the agent can manage to limit the influence of climate, the most he can do is to totally avoid the climate influence for his activity

# *Econometric models: type of data*

- Time series: Across time
- Cross section: Across agents
- Panel data: Across time and agents

# Some issues

- How to define the BASELINE is an important issue
- It is not easy to fit economic data and meteorological data (different geographical or temporal scales)
- Sensitivity analysis is necessary to evaluate uncertainty

# Conclusions

- There is no unique method allowing the correct evaluation of socio-economic benefits resulting from the meteorological information.
- Different methods can help in concrete situations.
- It is important to identify who are the stakeholders, which are their decisions and which of them are directly influenced by the information in order to decide which kind of evaluation can be useful to quantify the benefits.

***Thank you very much for your attention!***

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