UNCERTAINTY: α–precautionary principle or real options analysis?

How to quantify cost and benefits

Alexander Golub
Metroeconomica

Background

- Near-term decision regarding climate policy should be made in context of uncertainties.
  - Naïve to think that regulator will be able to select an “ideal” policy before uncertainties are narrowed;
  - Initial policy would be inevitably corrected;
  - Estimating cost of climate policy regulator should also take into account **correction cost**.
- Uncertainties on climatic side are amplified by uncertainties on the side of socioeconomic system.
- Climate policy should be made when information is incomplete, therefore this decision generates risks.
- **The key issue:** how quantitative methods for economic analysis and risk management can help to make the best possible decision given incomplete information.

α−precautionary principle

- α−precautionary principle:
  - Offers an alternative to conventional cost-benefit analysis that focuses on central estimate of underlying parameters;
  - Considers both the worst case and best case scenarios, rather than focusing merely on uncertainty about harmful outcomes;
  - Offers to policy makes some methods to obtain economic value of underlying uncertain outcome based on three different numbers:
    - a) best case scenario;
    - b) worst case scenario; and
    - c) wait coefficient "alpha".
  - **Calibration proposed in the paper** "…the worst case scenario is grim, perhaps on the order of the end of civilization; the best case scenario is that harm from climate change is modest". Selection of alpha (about 0.01) reflects probability of catastrophic temperature increases (up to 20^0C – p. 13)

- **In sum, α−precautionary metrics is a weighted average of worst and best case scenarios:**
  - Omits states of the world in-between;
  - α−weighted value is less then expected value (taking into account omitted states of the world).

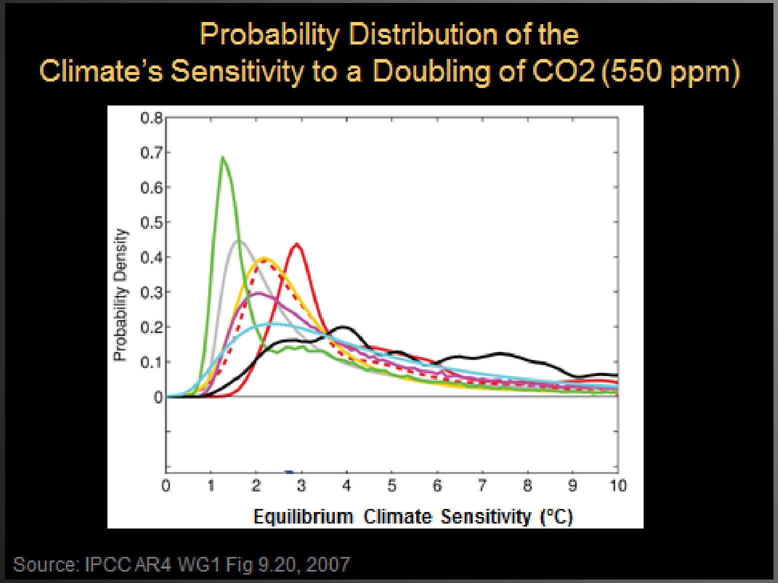
α–precautionary principle or real options analysis?

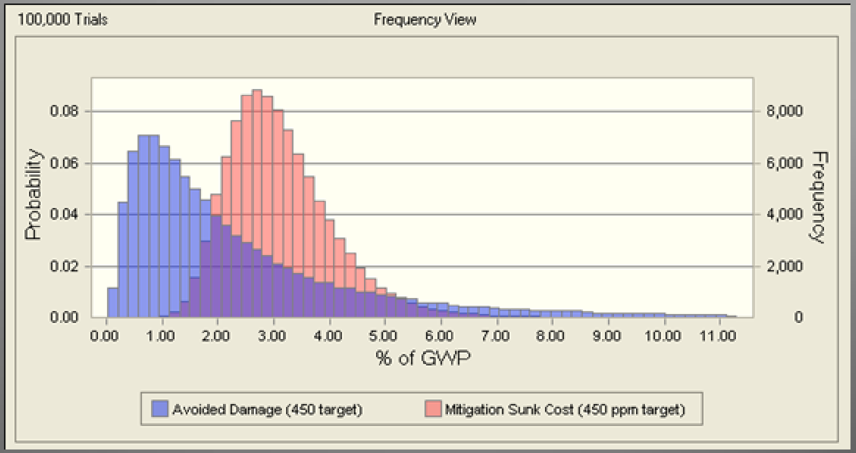
- "One way to understand these models [α–maxmin models] is that we might want to **minimize our regret** for making the wrong decision…" (p.8);
- In case of climate policy regrets could be interpreted as an unrecoverable damage and/or sunk abatement cost;
- Regrets on damage side are balanced by regrets on abatement cost side.
- **Real options methodology:**
  - Offers the way to calculate a shadow price of these regrets;
  - Gives to decision makers a tool to assess different emission reduction pathways and to act promptly responding to new information and knowledge on climatic system and economy.

Real Options and Climate Policy

- Irreversibility =>
  - Current decision on policy forecloses options to avert dangerous interference with climatic system, i.e. permanent productivity shocks.
- Learning =>
  - Option value of learning;
  - Value of flexibility.
- Dynamic heading=>
  - Correction of emission target in response to new knowledge:
    - Cost of correction = option value;
    - Cost of hedging strategy = value of option to correct emission target and avoid permanent shocks.
- Catastrophic damage=>
  - R&D into geo engineering = call option on geo engineering.

Climatic science and economics: probability distributions for critical parameters





Concluding remarks

- α-precautionary principle gives to policy makes point estimates of the worst and the best outcomes, as well as alpha-weight coefficient that could be derived from a probability distribution or set arbitrarily.
- If distribution exhibits infinite variance, then tail should be truncated at some point: *"Rather than trying to solve the intractable problem of the potential infinities in fat-tailed distributions, we can cut off the tail at some plausible "worst case"— but then make up for our inability to directly account for the full spectrum of outcomes by giving heavy weight to the chosen bad scenario".*
- In terms of truncation of a fat tail, option methodology could be explained as more sophisticated truncation technique. Strike price is a truncation point.
- Climate science and economics of climate change already have accumulated enough knowledge to propose plausible probability distributions for underlying uncertainty parameters;
- Advanced option pricing formulas take into account all four characteristics of distribution: mean, variance, skewedness and kurtosis, and, therefore, well account for tail risk. As a hedging tool, options control "invisible" cost of climate policy.