Cost Benefit Analysis

Benefits
- Transportation
- Light
- Medical
- Heating

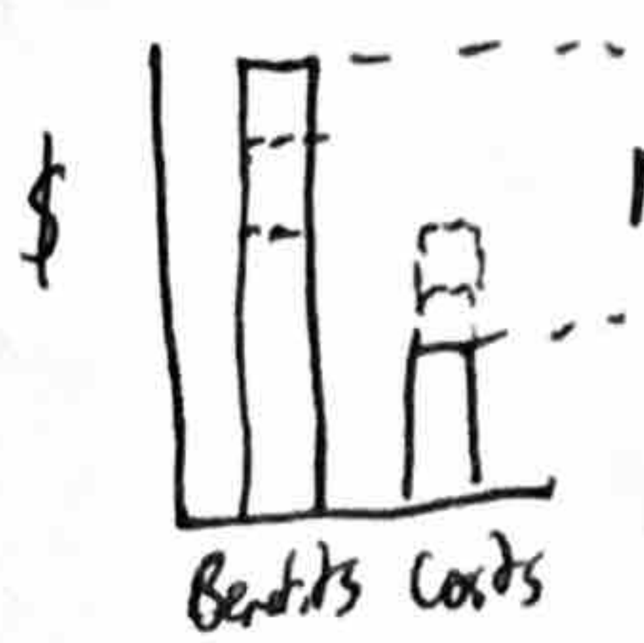
Costs

Externalized:
- Climate change
- Air pollution
- Extreme weather
- Droughts
- Flooding

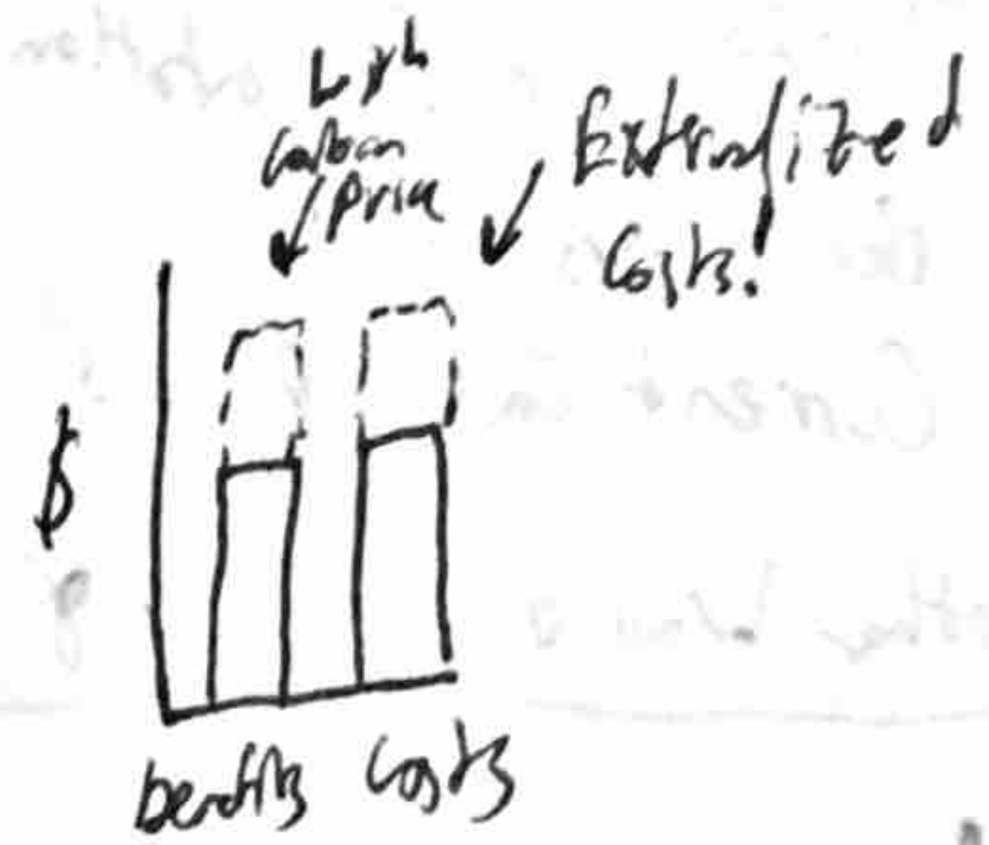
Internalized:
- Extraction
- Transportation
- Refining

CO_2 from

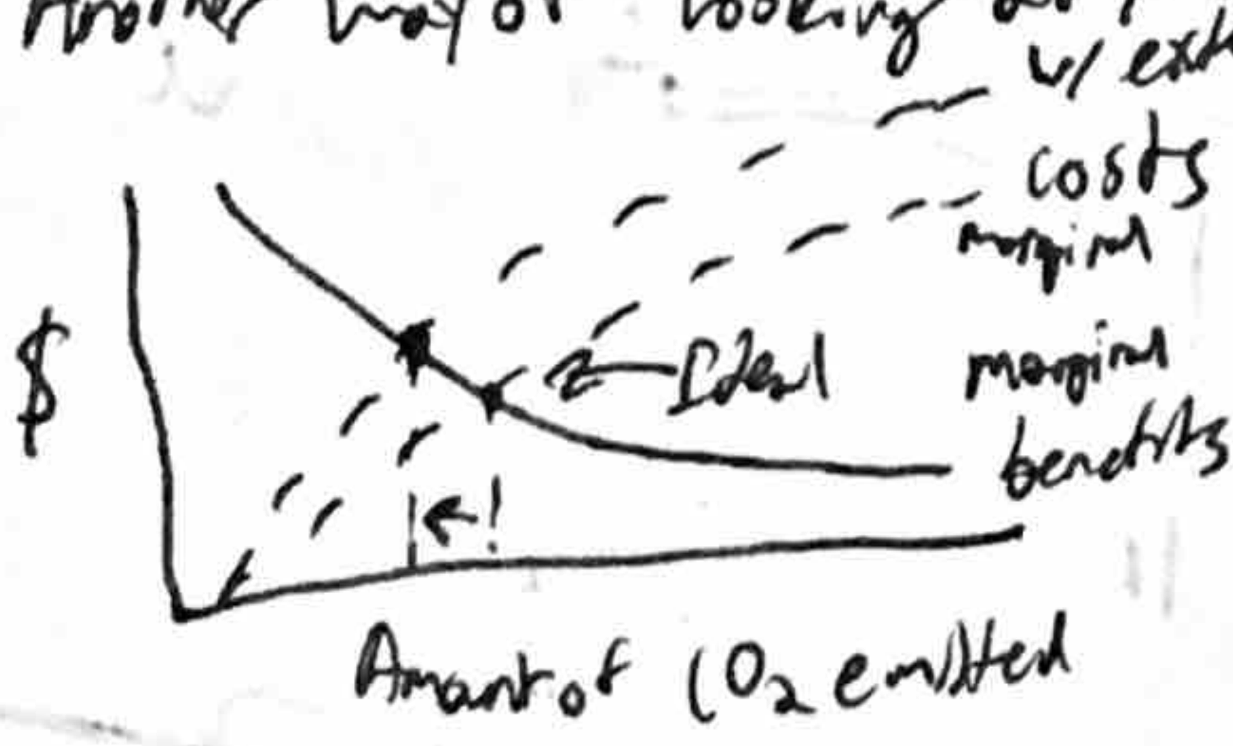
Burning the first barrel of oil:



→ Nth barrel



Another way of looking at it:



Mathematically: $U(Q) = B(Q) - C(Q)$

$$\frac{\partial U}{\partial Q} = \frac{\partial B}{\partial Q} - \frac{\partial C}{\partial Q} = 0$$

← maximization condition

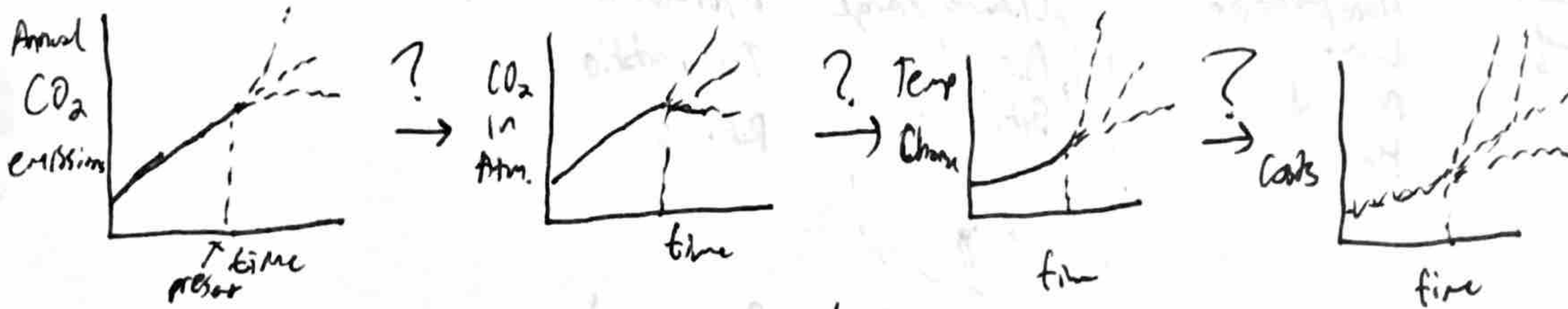
Thus, for ideal policy: $\frac{\partial B}{\partial Q} = \frac{\partial C}{\partial Q}$

In order for this to happen we need to internalize the externalities.

One way to do this is by adding a tax equal to the externalized marginal costs

↳ Won't discuss many important points today. Including what is done w/ revenue. Focus on how to determine ideal price.

Determining Marginal Externalized Costs?

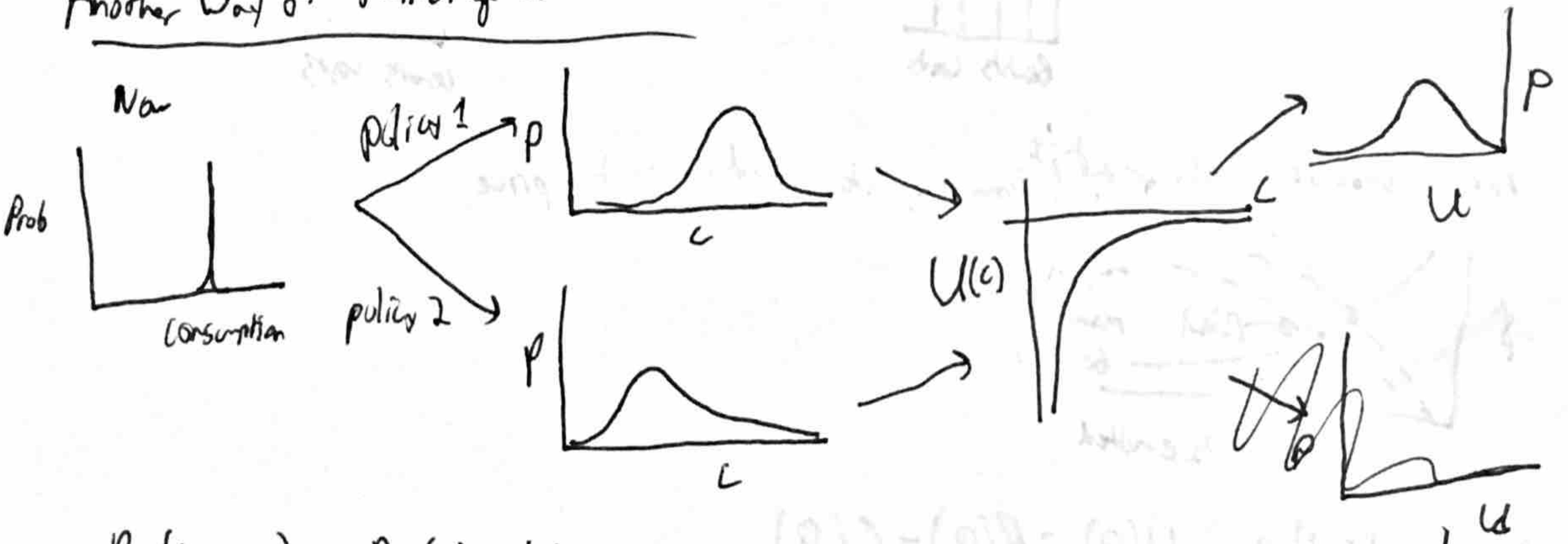


↳ Questions in Presentation + DICE model

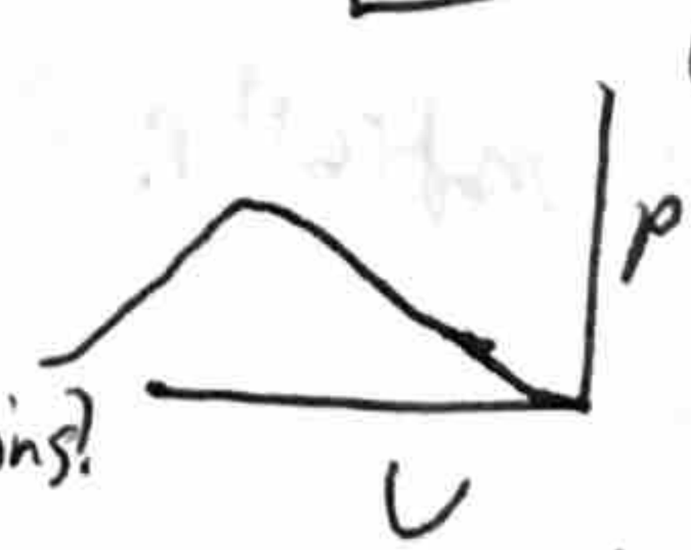
Burke Results

Current Carbon Prices

Another Way of thinking about CBA



$$P_r(U_{future}) = P_r(c) \cdot U(c)$$



What if $c \to 0$? $P_r(c) \to 0$, but $U(c) \to -\infty$. Which wins?

Depends on how quickly they go to zero. Standard CBA uses $U(c) = \frac{c^{1-\alpha}}{1-\alpha}$ (constant Relative Risk aversion)

What do we know about $P_r(c)$?

Weitzman's Dismal Theorem: In the case of minimal prior information about $P_r(c)$
2009 the "best guess" distribution always goes to zero more slowly than $U(c) \to \infty$ for any finite number of samples N from $P_r(c)$.

Thus $E[U_{future}]$ is dominated by the catastrophic tail.

How can we think about Catastrophe?

If this is true, then for almost all cases where there is uncertainty and a chance of catastrophe we should be willing to pay almost all of current consumption to stave it off. Obviously not true in practice. What can we do instead?

Thought Experiment: You need to buy a car. Cars sometimes explode and kill you. Baseline chance of that happening is 1/100,000. Can pay for extra safety feature to make it 1/200,000. How much are you willing to pay for safety feature?

→ Any answer < 100% of income puts an implicit value on life.
Ex: Let's say on average people pay \$500 more. If 200,000 people pay $200{,}000 \cdot \$500 = \$100$ million. That reduces number dead from 2 to 1.
Thus value \$100 million/Life. → $U(c=0) \neq -\infty$

→ In the case of Climate Change we can define a "Statistical Value of Civilization" λ
This allows us to get a concrete answer for $E[U]$, but then the choice of λ dominates more than anything considered in e.g. DICE.
↳ Rather than figuring out discount rate, damage function, etc. we should care about value of civilization and chances of catastrophe?

NordHaus's Weaker Dismal Theorem

Assume that in the tail most distributions (fat tail) look like a Pareto Distribution $Pr(c) \propto c^{\beta+1}$
For example, works well with earthquakes.

then, using CRRA, $Pr(c) \cdot U(c) \propto c^{\beta+1} c^{1-\alpha} = c^{\beta+2-\alpha}$ converges if $\beta+3-\alpha<0$
that is, only a problem if very fat tail (β small) and high risk aversion (α large)
→ Look at historical catastrophes