EC1340-Fall 2023

Midterm solutions
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1. Idiosyncratic

2. Idiosyncratic

3. Let

$$\begin{aligned} C &\sim \text{Tons of Carbon mitigation} \\ p_c &\sim \text{unit cost of mitigation} \\ p_c C &\sim \text{Total cost of mitigation} \end{aligned}$$

   The first two problems should have resulted in an estimate of C and $p_c C$ for your policy. Use C to calculate the implied change in climate from your policy.

   1ppm C is 2.12 GtC and of each ton of emissions, 0.55 stays in the atmosphere. Thus 1 ton of emissions results in $\frac{0.55}{2.12\times10^9} \approx \frac{1}{3.8\times10^9}$ppm. Thus, C tons results in a change in concentration of $\approx \frac{C}{3.8\times10^9}$ppm.

   Using Nordhaus' estimate of climate sensitivity, doubling atmospheric concentration from 280 to 560ppm give 3 degrees Celsius of warming by 2100.

   Thus, C tons of emissions gives $\frac{C}{3.8\times10^9} \times \frac{3}{280}$ degrees of warming by 2100. Call this change ΔT^*

4. Calculate the flow of damages from this ΔT^*. You can either use Nordhaus' damage function, given in slides #4 slide 50, or $\gamma = 0.01$ from slide 55 of slides #5. The second way is easier.

   From the equation 6 of BDICE

$$\begin{aligned} c_2 &= [(1+r) - (\delta T^*)]I \\ &= [1 + r - \gamma(\delta T^*)]I \end{aligned}$$

   so ΔT^* causes a $0.01\Delta T^*$ percent decrease in future consumption.

   Let W_1 denote future consumption. This should be a value calculated from current GDP. For example, if $g = 1.03$ and we are thinking about W_1 happening in 80 years, then $W_1 \approx 1.03^{80}\times$ Current GDP.

   Let the annual cost/benefit of your policy starting in 2100 be $0.01 \times \Delta T^* \times W_1 \equiv \Delta W_1^*$.

5. Suppose we experience the benefit ΔW_1^* every year from 2100 on. Then the discount present value of this flow of benefits is

$$\begin{aligned} V^* &= \sum_{t=78}^{\infty} \delta^t \Delta W_1^* \\ &= \delta^{78} \sum_{t=0}^{\infty} \delta^t \Delta W_1^* \\ &= \frac{\delta^{78}}{1-\delta} \Delta W_1^* \end{aligned}$$

   You should evaluate this last expression for $r = 0.03$ (or some other particular r, or $\delta = 1/(1.03)$

Thus, $V^* \approx (0.97)^{78} \frac{1}{1-1.03} \Delta W_1^*$

A policy is a good idea if the discount present value of benefits, V^* is large compared to the total value of the policy, $p_c C$ that you calculated in part 2. If your policy has a price per ton of mitigation above 400$tC, the highest tax on Carbon tax that any of Stern/Gor/Nordhaus propose, then it is probably not a good idea.