Evaluation guidelines ECON2920 Spring 2022
University of Oslo, Departement of Economics
Tuesday May 31st. 09:00-12:00

Instructions:

(i) The exam is a three hour digital school exam

(ii) All problems should be solved and they are given the weights reported in brackets.

(iii) For each question, unless stated otherwise, you can either provide a graphical illustration or use an analytical approach (calculus). Both approaches deserve full credit as long as the claims are supported by convincing arguments.

(iv) Restrict your answer to what the exercise asks for, no credit is given to non-relevant information.

(v) Full credit is only given to figures and graphs that are fully explained, that have notation on the axis and that are correctly illustrated

(vi) You are allowed to answer in Norwegian or English. The exam is only given in English

This exam consists of 4 main questions. The weight of each question is indicated.

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Question 1. Public goods (10 points)

(a) **(5 points - short answer - words and graph)**
What is a 'public good' and what determines the optimal amount of a public good in the social planner solution? How is this different from the solution in the competitive market? Explain and include a graphical illustration.

(b) **(5 points - short answer - words)**
Give an example of an environmental public good and a public bad.

Question 2. The target (30 points)

Consider a flow pollutant E. The net benefits from pollution, NB, is defined as pollution benefits minus pollution damages:

$$NB = B(E) - D(E) \tag{1}$$

In our case the damage function is convex, hence $D'(E) > 0$ and $D''(E) > 0$, and the utility function is concave, hence $B'(E) > 0$ and $B''(E) < 0$.

(a) **(5 points - short answer - words)**
Explain what we mean with "pollution benefits" and what is the implication of a concave benefit function?

(b) **(5 points - short answer - calculus and figure)**
Show how to solve the maximization problem. Illustrate the net benefits with a figure, and mark the business as usual level (BaU) and the target.

(c) **(5 points - short answer - words)**
Explain what we as environmental economists mean by "the optimal level of pollution". When can it be socially optimal with zero pollution?

(d) **(15 points - long answer - words, calculus and figure)**
Equation (1) defines the trade-off (net benefit) in terms of pollution. Rewrite the net benefit in terms of abatement instead, illustrate in a figure and explain in words how to intepret the curvture of the functions.

Question 3. Regulating a pollutant (30 points)

Suppose the National Environmental Agency calculated the optimal target E^* of the toxic pollutant in Question 2. In this economy there are two main agents that create pollution in their production process, $B(E) = B_1(E_1) + B_2(E_1)$. Firm 1 is the cement industry and Firm 2 is a chemical manufacturer. The regulator needs advice on how to best reduce pollution. Suppose we know the firms' technologies, such that we can draw the following:

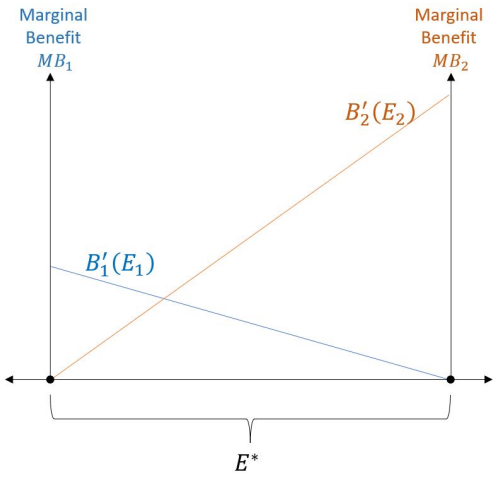

Figure 1: Optimal level of emissions and the two marginal benefits

(a) **(5 points - short answer - words and figure)**
In Figure 2, the marginal benefit is steeper for Firm 2 than for Firm 1. What does this imply? Can you give an example of when this might be the case?

(b) **(5 points - short answer - words)**
The regulator suggests an "equal for all"-policy that sets an emission cap per firm $i = 1, 2$, given by $\bar{m}_i = E^*/2$. What type of policy is this? Briefly discuss the pros and cons of this regulation (use the figure above in your arguments).

(c) **(5 points - short answer - words and figure)**
The regulator suggests forbidding pollution from the chemical manufacturer. Meanwhile, the cement industry is allowed to pollute the amount E^*. What is the welfare loss from this policy choice? Briefly discuss the pros and cons (use the figure above).

(d) **(15 points - long answer - words and figure)**
Explain to the regulator how a quota market with tradable permits works, using the figure above. What determines the price of quotas (permits) in this market? Can the government establish a cost-effective quota market without knowing the firms' technology (and thus knowing their actual abatement cost)?

Question 4. Global climate change (30 points)

In this exercise we will discuss climate change and emissions of carbon dioxide (CO_2) and other greenhouse gases (GHGs).

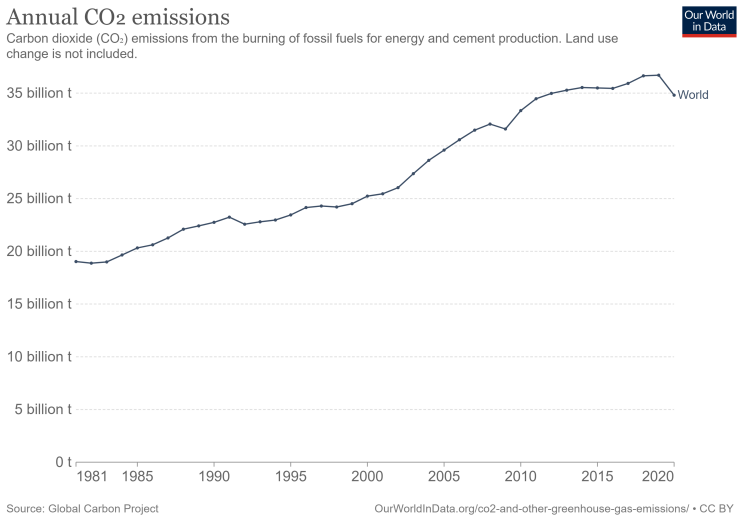

Figure 2: Global CO_2 emissions from fossil fuels, 1981-2020.

30 years ago 154 countries signed the first climate treaty, the UN Framework Convention on Climate Change, where they agreed to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system" (UNFCCC, 1992). Figure 2 shows that CO_2 emissions have continued to rise since then.

(a) **(5 points - short answer - words)**
Explain what it means that countries are "sovereign states". What are the implications for international environmental agreements?

(b) **(5 points - short answer - words)**
Why should the global carbon tax be equal across countries?

(c) **(5 points - short answer - words)**
What is the difference between stock and flow pollution and why do we need to take this distinction into account when discussing solutions to the climate problem? What type of pollution is illustrated in Figure 2?

(d) **(15 points - long answer - words/calculus/figure)**
Climate change is a global problem. What is the mechanism that prevents countries from achieving full cooperation? Explain why the Nash equilibrium of a climate treaty game never will be social optimal. Use either words, calculus or a figure to explain.