ECN 275/375 – Natural resource and environmental economics
12:15-15:15 March 5, 2024

All help aids allowed except assistance from others.
This test consists of 3 questions, for a total score of 100 points.
All questions are to be answered. You may answer in English or Norwegian.

In the case that you find a question unclear, or you are uncertain about what is meant, state the extra assumptions you need to be able to answer the question.

This test has been designed to limit the benefits of using Chat GPT and similar artificial intelligence tools. If AI use is detected beyond reasonable doubt, unreported use leads to a score of zero. Students can use AI tools if they self-report such use at a cost: A question with self-reported AI use reduces the score by 40%.

**When I submit my answers on this test, I confirm that I have worked alone on my answers and not cooperated with others. I am aware that cooperation with others is considered an attempt or a contribution to cheating.
I am aware of the consequences of cheating (Ch. 39, Academic regulations for NMBU).**

Your name: NN (+ ECN 275 or ECN 375)

Question 1 (30 points – 10 points for each part a-c)

There are 2 firms, A and B, each with a maximum production capacity of 12 units of the same type public (non-market) good with the following **total cost functions of producing the public good**, Q:

The A-firm: $TC_A(Q_A) = Q_A^2/2$, and the B-firm: $TC_B(Q_B) = Q_B^2/4$.

(a) (i) Currently neither of the firms produce any of the public good. Draw the marginal cost functions for the two firms in the same graph. Mark the axes and the two firms' respective marginal cost functions. Explain how each of the two firms responds to a subsidy rate $S' = 2$ for producing the public good. In the graph, mark the two firms' responses to the subsidy with Q_A' and Q_B'. **For firm A** mark the total amount of subsidies received in your graph.

(ii) Replace the subsidy by the tax rate, $T' = S' = 2$, and mark the area of taxes paid **by firm A** in your graph. Explain the difference in the impact on firm A from the subsidy and the tax. What kind of effect does the subsidy-tax example illustrate?

Answer: (i) Write here

(ii) Write here

For parts (b) and (c) you do not need to present your solutions graphically.

(b) (i) Each firm is required to produce at least half of their maximum production capacity, i.e., $\bar{Q}_A = \bar{Q}_B = 6$. Show that this is not a cost-effective policy.

(ii) Find the cost-effective distribution of producing a total of 12 units of the public good, i.e., $Q_A' + Q_B' = 12$.

Answer: (i) Write here

(ii) Write here

(c) Change total required emissions reductions to 9, i.e., $Q_A'' + Q_B'' = 9$.

(i) Write down the condition for a per-unit production of emissions subsidy S'' giving a total number of emissions reduction of 9, calculate S'' and the two firm's respective produced emissions reductions, Q_A'' and Q_B''.

(ii) Assume that even with only two firms, the conditions for a well working market are met. Find the resulting market price P''.

Answer: (i) Write here

(ii) Write here

Question 2 (30 points – 10 points for each part a-c)

Characteristic features of nonpoint source pollution are that it is technically difficult or costly to measure the amount of pollution. The term nonpoint source pollution originates from agriculture where measuring phosphorus and nitrate runoffs from farm fields is difficult as it requires collecting drainage water to measure the concentration of nutrients, and hence enable assessing the soil nutrient runoffs. Phosphorus is a main driver for eutrophication in freshwater recipients, causing algae growth which reduces water clarity and leaves less oxygen available for other species. The latter could alter the species composition as stocks (amounts) of salmon and other species requiring high oxygen concentrations are reduced. In extreme cases the affected species may die. The environmental damages from phosphorus runoffs generally occur close to or downstream from the source of the emissions.

(a) (i) Using salmon as an example, show why the optimal amount of phosphorus emissions are likely to differ between high and low valued salmon rivers. Illustrate your reasoning and findings using a graph.

(ii) In Norway farmers frequently also owns the (salmon) fishing rights in rivers and lakes on or bordering to their properties. How could that influence farming practices?

Answer: (i) Write here

(ii) Write here

The damages of nitrate runoffs are small in freshwater recipients. However, their negative impacts are strong in coastal waters, particularly where water from rivers enters the sea.

(b) For nitrogen the tax rate, t, on industrially produced nitrogen fertilizers, N, lowers emissions. Use a simplified production function where per hectare yields, Y, is a function of nitrogen use, N, per hectare, i.e., $Y = f(N)$. Define the additional terms needed to write an appropriate profit function with and without an input nitrogen tax. Show mathematically why the tax t reduces the use of nitrogen when the production function $f(N)$ has the standard properties in stage II of the production function, i.e. where $f'(N) > 0$ and $f''(N) < 0$. Draw a graph to illustrate your reasoning.

Answer: Write here

(c) (i) Show how the tax rate, t, on industrially produced nitrogen increases the use of manure ("shit" from on farm animals) when the farmers seeks to produce the same amount of products as the did before the tax on industrially produced nitrogen was introduced.

(ii) Explain why this effect could be uncertain under profit maximization.

Answer: (i) Write here

(ii) Write here

Question 3 (40 points – 10 points for each part a-d)

In a country about 40% of the gross domestic product comes from one sector in the economy. Nearly all of the goods produced in this sector are exported. The government is considering one of two economy wide policies to reduce emissions of this nontoxic pollutant. Its negative environmental impacts are mainly domestic.

    i.   Non-transferable grandfathered emission permits to be implemented *two years into the future*, where existing firms both within and outside the export sector are given an emission quota based on their emission level next year.

    ii.   A uniform emission tax for all sectors, where the tax rate is to be reduced for the export industry sector to avoid negative impacts on export revenues.

There is close to full employment and little slack in the economy.

(a) Suppose you are an advisor in environmental economics to the government. What changes would you recommend to the emission permit system? Briefly justify your changes.

Answer: Write here

Representatives for the polluting export industry argue against both proposals, claiming that either policy will be very harmful to the industry because it sells its products in a highly competitive international market, which in turn could reduce national welfare. They therefore suggest voluntary regulations, where the exporting industry agrees to cut its emissions by half within ten years if the government promises not to introduce other regulations negatively affecting the competitiveness of the industry in the same time period.

(b) Briefly discuss the export industry arguments related to export revenues and welfare losses, their opposition towards any environmental regulations except their own proposal on voluntary environmental agreements.

Answer: Write here

Representatives for businesses outside the export sector argue against the tax proposal as it increases the challenges for the domestically oriented firms to attract scarce labor with the same skills demanded by the tax-exempt export sector. Firms focusing on the domestic markets therefore favor a system with grandfathered emission permits, i.e., proposal (i) by the government.

(c) Discuss the validity of the arguments made by the domestically oriented firms regarding labor market impacts and the desirability of grandfathered tradable pollution permits.

Answer: Write here

The tax-payer association favors the emission tax proposal, arguing that the introduction of the emission tax will allow for lowering other distorting taxes, in particular on labor income. They claim the emission tax will produce massive welfare gains as lower tax rates on labor will induce people to work more, thereby compensate for the losses incurred by export firms.

(d) Discuss the validity of the claim made by the tax-payer association regarding the labor market and welfare effects of the proposed emission tax as it allows for lowering labor taxes.

Answer: Write here

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