Public Economics

Fall 2024

Midterm Exam

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1. You have a total of 80 minutes (1 hour and 20 minutes) to solve the exam.
2. The use of calculators is not allowed.
3. If you need additional space to answer a question, you can use the back *of the same page*.

Read each question carefully. Good luck!

I (6 points)

Discuss the following statements (*max. 10 lines for each*).

a. For efficiency, club goods should not have exclusion prices.

Club goods are non-rival and excludable. For efficiency, indivisible goods should be made available to all agents (with no exclusion), as long as the marginal cost of congestion is 0. Also for efficiency, the Samuelson condition would then be applied, including all agents in the calculation of the aggregate marginal benefit. However, no exclusion would also lead to free-riding and this would call for public provision (which may or may not lead to efficiency, depending on access to information, collective decision-making and political economy considerations).

Grading: 0.75 for definition of club goods; 1.25 for main conclusion and additional discussion.

b. In an economy with two goods and two agents with well-behaved preferences, efficiency and no-envy are compatible.

True. If preferences are well-behaved, a walrasian equilibrium from equal division exists. As long as there is a walrasian equilibrium from equal division, it must be efficient (1st Welfare Theorem) and envy-free (since all agents maximize utility subject to the same budget constraint that includes equal division).

Grading: 0.5 for mentioning the walrasian solution from equal division, 0.5 for explaining efficiency and 0.5 for explaining no-envy, 0.5 for conclusion.

c. When there are different costs of reduction of pollution for different firms, moving from a uniform reduction to a Pigouvian tax will lead to a Pareto improvement.

If there are several firms with possibly different costs of reduction, a uniform reduction would be worse (in terms of efficiency) than a Pigouvian tax that would allow flexibility and different reduction levels for each firm. However, moving from inefficiency to efficiency does not ensure a Pareto improvement (and firms that would end up reducing more under the tax would become worse off).

Grading: 1 for the efficiency comparison of quantity and price intervention with different costs of reduction, 1 for the conclusion on Pareto improvement.

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II (4 points)

Consider an economy with two consumers with utility functions $U_1 = x_1 + 2y_1$ and $U_2 = 2x_2.y_2$. Assume there are 2 units of x and 1 unit of y to distribute among the agents.

a. (2.25 points) Using an Edgeworth box, find the set of Pareto efficient points and find the utility possibility frontier.

Efficient allocations will be such that $x_1=2y_1$ and $x_2=2y_2$
Then, for all efficient allocations, $U_1=2x_1$ and $U_2 = x_2^2$. Therefore, $U_2=(2-x_1)^2$ and $U_2 = (2-U_1/2)^2$

Grading: 1.25 points for the description and justification of efficient allocations (including Edgeworth box); 1 point for the calculation of the UPF.

b. (1.75 points) Find the utilitarian choice for this economy. Will the resulting allocation be egalitarian-equivalent?

We want to maximize U_1+U_2 s.t. $U_2 = (2-U_1/2)^2$
We reach two corner solutions: $U_2 = 4$ and $U_1 = 0$ or $U_1 = 4$ and $U_2 = 0$
The resulting allocations are, respectively, $x_2=2$ and $y_2=1$, $x_1=y_1=0$; or $x_1=2$ and $y_1=1$, $x_2=y_2=0$.
The first allocation is not egalitarian-equivalent; the second one is, with a reference bundle (3,0) or (3/2,0).

Grading: 0.5 for the formulation, 0.5 for the solution, 0.75 for the conclusion on egalitarian-equivalence (including 0.25 for the concept).

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III (6 points)

A chemical producer dumps toxic waste into a river. The waste reduces the population of fish, reducing profits for the local fishery industry by 1,000 per year. The firm could eliminate the waste at a cost of 500 per year. The local fishing industry consists of many small firms.

a. (1 point) Apply the Coase theorem to explain how costless bargaining could lead to a socially efficient outcome, no matter to whom property rights are assigned (either to the chemical firm or the fishing industry).
(max 8 lines)

In this specific case, as the benefits of eliminating the waste are higher than the costs of doing so, it would be efficient to eliminate the waste.
If initial rights were to be assigned to the chemical producer, the producer would require a minimum payment of 500 to eliminate waste, while the local fishing industry would be willing to pay up to 1000. Therefore, a payment between 500 and 1000 would take place and waste would be eliminated.
If initial rights were to be assigned to the fishing industry, the latter would require a minimum payment of 1000 to allow waste to be produced, while the producer would only be willing to pay up to 500. Therefore, no transaction would take place, and waste would be eliminated.

Grading: 0.2 for the efficient outcome and 0.4 for each assignment of rights
(Note: a bonus of 0.25 was given for discussing the Theorem, a penalty of 0.1 was given if the number of lines was largely exceeded)

b. (1 point) Do you see any reason why the Coase theorem result might not apply to this situation? (max 8 lines)

As the local fishing industry consists of many small firms, transaction costs should not be negligible.
Moreover, this fact also facilitates the arise of free-riding problems (among other problems)

Grading: 0.65 for the conclusion that the problem is the number of firms/transaction costs and 0.35 for the identification of any other possible problems

Assume now that the total (net) benefit for the chemical producer associated with the production of toxic waste (w) is $100w-5w^2$. Assume there are 10 small firms in the fishing industry and each of them has a cost of w^2 associated with the toxic waste.

c. (1.5 points) What would be the socially optimal level of toxic waste?

Max $(100w-5w^2) – 10\ (w^2)$, which implies that $w^*=10/3$
Grading: 1 for the correct maximization problem and 0.5 for solving it

d. (1 point) Find the Pigouvian tax that the government could impose to achieve the socially optimal level.

$t = MD(w=10/3) = 20*10/3 = 200/3$

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Grading: 0.5 for an adequate way to find the Pigouvian Tax and 0.5 for using the correct function

e. (1.5 points) Assume that the Government specifies that toxic waste is forbidden unless the chemical producer buys pollution licences from the firms in the fishing industry (assume that it is an association of all 10 firms that sells the licences, considering the total costs for the 10 firms). What would be the equilibrium quantity and price of pollution licences?

Let p = price of pollution licence
Chemical producer solves:
Max $100w - 5w^2 - pw$, which implies $w = 10 - p/10$
Fishing firms solve:
Max $pw - 10w^2$, which implies that $w = p/20$
Equilibrium:
$10 - p/10 = p/20 \leftrightarrow p = 200/3 \rightarrow w = 10/3$
The equilibrium quantity will converge to the socially optimal level (10/3), while the price of production licenses will converge to the value of the Pigouvian tax (200/3).

Grading: 0.5 for the firm's maximization problem, 0.5 for the fishing firms' maximization problem and 0.5 for the equilibrium

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IV (5 points)

Suppose that your neighborhood association is considering building a park (that would only be available for the neighborhood). Let Q denote the number of hundreds of square meters of the park. There are two groups of people with different preferences. There is a group of 6 people where each person has a demand given by Q = 10 – P and a group of 4 people where each has a demand given by Q = 10 – 2P/3. The cost of building each hundred square meters is 60.

a. (1.5 points) What is the socially optimal size of the park?

Group A : P=10-Q
Group B : P= 15-3Q/2

Samuelson Condition: 6(10-Q)+4(15-3Q/2)=60 (=) Q*=5

Grading: 0.5 for the Samuelson Condition and 1 for the aggregation/solution

b. (1 point) If the association were to set Lindahl tax-prices to finance the park, what would be the tax-price for each person?

Ta = 10-Q* = 5
Tb = 15-3Q*/2= 15/2

Grading: 0.5 for the adequate way to find the Lindahl Tax and 0.5 for the solution

c. (1 point) Assume that in the association everyone knows that there are only those two possible types of individual demands. However, each agent will need to be asked to report their own demand function. If agents know that Lindahl tax-prices will be set according to their announcements, what do you predict will happen? (max. 6 lines)

All 15 individuals would report Pa=10-Q (Preference Revelation Problem)
In this case: 10*(10-Q)=60 (=) Q=4
The free riding behavior would lead to an underprovision of the size of the park.

Grading: 0.5 for mentioning the free rider problem; 0.5 for connecting that with preference revelation and a specific prediction

d. (1.5 points) Since it may be difficult to achieve information on individual valuations, the association is considering applying a uniform tax price and letting the majority decide on the size of the park. One of your neighbors claims to also have studied Public Economics and says: “Although the majority decision will be the outcome preferred by the median voter,

this is not efficient because the preferences are not single-peaked". What would you tell your neighbor? (max 10 lines).

The first part of the statement is true – preferences are indeed single-peaked and therefore, the majority decision will be the outcome preferred by the median voter.
The second part of the statement is false – The median voter outcome is not guaranteed to be efficient because the intensity of preferences is not taken into account, however the potential inefficiency of this outcome is related with the intensity of preferences and not with whether the preferences are single-peaked (which they are).

Grading: 0.5 for the median voter theorem; 1 for the discussion on efficiency of the median voter choice and conclusion.

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