University of Athens

Department of Economics — Academic year 2023-2024

Fall-Winter term

Course: Public Finance

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Assignment No 2. ***Answers***

A. Multiple choice questions (Correct answers are in bold italics)

1. A Pigovian tax is
   a. different for each firm in the industry that is responsible for the externality.
   b. a lump sum tax on the firms that are primarily responsible for the externality.
   c. a tax equal to the aggregate marginal damages at the optimum.
   d. does not rectify the problems created by an externality.

2. Coase argued that to solve the problem of externalities, the government needs to
   a. leave the market to itself.
   b. set a maximum limit on production of the good producing the externality.
   c. levy a Pigovian tax equal to the sum of the marginal external damages at the optimum.
   d. establish ownership of property rights.

3. Which of the following is an important caveat to the Coase Theorem?
   a. It only applies if the scope of the externality is quite limited.
   b. It only applies to externalities generating benefits.
   c. It only applies to externalities generating costs.
   d. It only applies in theory.

4. The Samuelson Rule states that efficient provision of a nonexclusive good occurs where
   a. all individuals' marginal rates of substitution are equal.
   b. the sum of the individuals' marginal rates of substitution equals the sum of the firms' marginal costs at the optimum.
   c. the sum of the individuals' marginal rates of substitution equals the marginal rate of transformation at the optimum.
   d. the sum of the individuals' marginal rates of substitution equals the sum of the marginal rates of transformation at the optimum.

5. The difference between the Samuelson Rule for nonexclusive goods and the Pareto-optimal Rule for exclusive public goods is that
   a. with nonexclusive goods, when an extra unit is provided everyone is affected, so that the marginal benefit is the sum of the individuals' marginal rates of substitution.
   b. with exclusive goods, when an extra unit is provided everyone is affected, so that the marginal benefit is the sum of the individuals' marginal rates of substitution.
   c. with nonexclusive goods, when an extra unit is provided only those who purchase it are affected, so that the marginal benefit is the sum of the individual marginal rates of substitution.
   d. with nonexclusive goods, when an extra unit is provided only the individual who purchases it is affected, so that the marginal benefit is that individual's marginal rate of substitution.

6. Free riding is a problem with nonexclusive goods because
   a. the government has a self-interested incentive to hide information from its citizens.
   b. ***individuals have a self-interested incentive to hide information from the government***.
   c. the government has too much information.
   d. individuals have too little information

7. Public goods can be
   a. provided privately.
   b. provided publicly.
   c. subject to free rider problems.
   d. all of the above.

8. Externalities can be positive because
   a. marginal damages do not last over time.
   b*. *utility can be impacted positively as well as negatively.
   c. there is no concept for marginal benefit.
   d. positive externalities are subsidies.

9. The median voter is powerful because
   a. median preferences are also the most common preferences.

b. politicians naturally prefer middle positions.

c. median preferences please half the people more than any other choice.

d. a middle position makes lobbying efforts more credible.

10. The voting paradox refers to

a. the power of the median voter, who may be poor.

b. the lack of incentives for people to vote.

c. the power of ill-informed voters to achieve efficient outcomes.

d. inconsistent choice making through majority voting

B. Problems

Problem 1.
Tarzan and Jane live alone in the jungle and have trained Cheetah both to patrol the perimeter of their clearing and to harvest tropical fruits. Cheetah can collect 3 pounds of fruit an hour and currently spends 6 hours patrolling, 8 hours picking, and 10 hours sleeping.

a. What are the public and private goods in this example?

b. If Tarzan and Jane are each currently willing to give up one hour of patrol for 2 pounds of fruit, is the current allocation of Cheetah's time Pareto efficient? Should he patrol more or less?

Problem 1. Answer
We assume that Cheetah's utility does not enter the social welfare function; hence, her allocation of labor supply across activities does not matter.

a. The public good is patrol; the private good is fruit.

b. Recall that efficiency requires $MRS^{TARZAN} + MRS^{JANE} = MRT$. $MRS^{TARZAN} = MRS^{JANE} = 2$. But MRT = 3. Therefore, $MRS^{TARZAN} + MRS^{JANE} > MRT$. To achieve an efficient allocation, Cheetah should patrol more.

Problem 2
Suppose that there are only two fishermen, Zach and Jacob, who fish along a certain coast. They would each benefit if lighthouses were built along the coast where they fish. The marginal cost of building each additional lighthouse is €100. The marginal benefit to Zach of each additional lighthouse is $90 - Q$, and the marginal benefit to Jacob is $40 - Q$, where Q equals the number of lighthouses.

a. Explain why we might not expect to find the efficient number of lighthouses along this

coast.
b. What is the efficient number of lighthouses? What would be the net benefits to Zach and Jacob if the efficient number were provided?

Problem 2. Answer

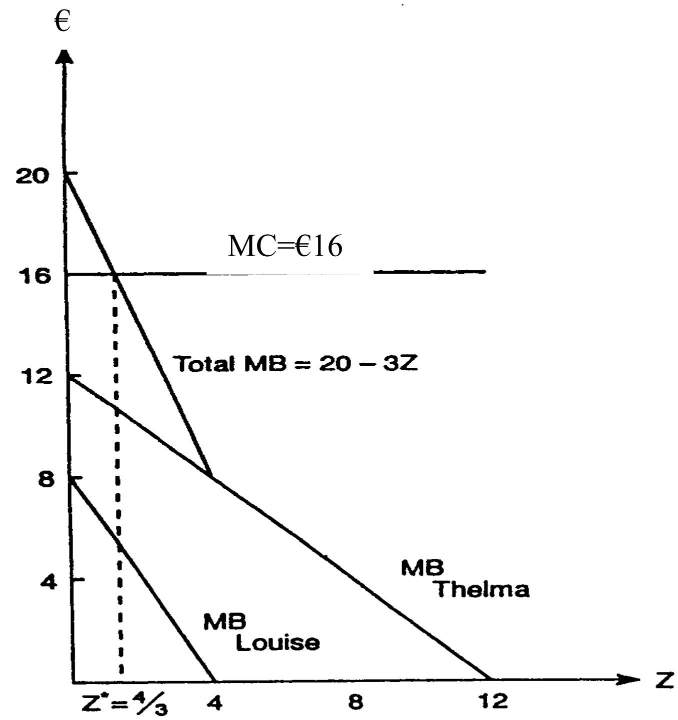
a. Zach's marginal benefit schedule shows that the marginal benefit of a lighthouse starts at €90 and declines, and Jacob's marginal benefit starts at €40 and declines. Neither person values the first lighthouse at its marginal cost of €100, so neither person would be willing to pay for a lighthouse acting alone.

b. Zach's marginal benefit is MB_{ZACH}=90-Q, and Jacob's is MB_{JACOB}=40-Q. The marginal benefit for society as a whole is the sum of the two marginal benefits, or MB=130-2Q (for Q≤40), and is equal to Zach's marginal benefit schedule afterwards (for Q>40). The marginal cost is constant at MC=100, so the intersection of aggregate marginal benefit and marginal cost occurs at a quantity less than 40. Setting MB=MC gives 130-2Q=100, or Q=15. Net benefit can be measured as the area between the demand curve and the marginal benefit of the 15^{th} unit. The net benefit is €112.5 for each person, for a total of €225.

Problem 3

Thelma and Louise are neighbours. During the winter, it is impossible for a snowplow to clear the street in front of Thelma's house without clearing the front of Louise's. Thelma's marginal benefit from snowplowing services is $12 - Z$, where Z is the number of times the street is plowed. Louise's marginal benefit is $8 - 2Z$. The marginal cost of getting the street plowed is €16. Sketch the two marginal benefit schedules and the aggregate marginal benefit schedule. Draw in the marginal cost schedule, and find the efficient level of provision for snowplowing services.

Problem 3. Answer
Thelma's marginal benefit is MB_{THELMA}=12-Z, and Louise's is MB_{LOUISE}=8-2Z. The marginal benefit for society as a whole is the sum of the two marginal benefits, or MB=20-3Z (for Z≤4), and is equal to Thelma's marginal benefit schedule afterwards (for Z>4). The marginal cost is constant at MC=16. Setting MB=MC along the first segment gives 20-3Z=16, or Z=4/3, which is the efficient level of snowplowing. Note that if either Thelma or Louise had to pay for the entire cost herself, no snowplowing would occur since the marginal cost of €16 exceeds either of their individual marginal benefits from the first unit (€12 or €8). Thus, this is clearly a situation when the private market does not work very well. Also note, however, that if the marginal cost were somewhat lower, (e.g., MC≤8), then it is possible that Louise could credibly free ride, and Thelma would provide the efficient allocation. This occurs because if Thelma believes that Louise will free ride, Thelma provides her optimal allocation, which occurs on the second segment of society's MB curve, which is identical to Thelma's MB curve (note that Louise gets zero marginal benefit for Z>4). Since Louise is completely satiated with this good at Z=4, her threat to free ride is credit if Thelma provides Z>4.



Problem 4

For each of the following situations, is the Coase Theorem applicable? Why or why not?
a. A farmer who grows organic corn is at risk of having his crop contaminated by genetically modified corn grown by his neighbours.
b. In Brazil it is illegal to catch and sell certain tropical fish. Nevertheless, in some remote parts of the Amazon River, hundreds of divers come to capture exotic fish for sale on the international black market. The presence of so many divers is depleting the stock of exotic fish.
c. In the state of Washington, many farmers burn their fields to clear the wheat stubble and prepare for the next planting season. Nearby city-dwellers complain about the pollution.
d. Users of the Internet generally incur a zero incremental cost for transmitting information. As a consequence, congestion occurs, and users are frustrated by delays.

Problem 4. Answer

a. It is very likely that the farmer could negotiate with the neighbours, provided property rights are clearly defined. The Coase Theorem is therefore applicable.

b. It is unlikely that property rights could be enforced in terms of catching tropical fish on the Amazon River. The question states that hundreds of divers illegally catch these fish and sell them on the black market. If the property rights were given to the divers, it is not clear who is actually harmed (perhaps "society as a whole") by the depletion of exotic fish. Given the large number of people who are harmed (in a small amount), and the large number of people who are engaging in this activity, it is not clear how bribes would flow from "society" to the "divers."

c. There are too many farmers and too many city-dwellers for a private negotiation.

d. Too many people are involved for private negotiation and impossible to figure out how to transfer bribes.

Problem 5.

The private marginal benefit for commodity *X* is given by 10 - *X*, where *X* is the number of units consumed. The private marginal cost of producing *X* is constant at €5. For each unit of *X* produced, an external cost (marginal damage) of €2 is imposed on members of society. In the absence of any government intervention, how much *X* is produced? What is the efficient level of production of *X*? What is the gain to society involved in moving from the inefficient to the efficient level of production? Suggest a Pigouvian tax that would lead to the efficient level. How much revenue would the tax raise?

Problem 5. Answer

Private Marginal Benefit = 10 - X

Private Marginal Cost = €5

External Cost = €2

Without government intervention, PMB = PMC; X = 5 units.

Social efficiency implies PMB = Social Marginal Costs = €5 + €2 = €7; X = 3 units.

Gain to society is the area of the triangle whose base is the distance between the efficient and actual output levels, and whose height is the difference between private and social marginal cost. Hence, the efficiency gain is ½ (5 - 3)(7 - 5) = 2.

A Pigouvian tax adds to the private marginal cost the amount of the external cost at the socially optimal level of production. Here a simple tax of €2 per unit will lead to efficient production. This tax would raise (€2) (3 units) = €6 in revenue.

Problem 6.

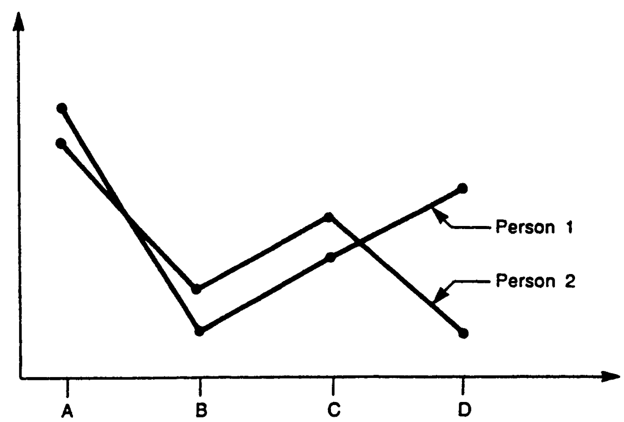
Suppose there are five people—1, 2, 3, 4, and 5—who rank projects A, B, C, and D as follows:
a. Sketch the preferences, as in Figure 6.2.

b. Will any project be chosen by a majority vote rule? If so, which one? If not, explain why.

1	2	3	4	5
A	A	D	C	B
D	C	B	B	C
C	B	C	D	D
B	D	A	A	A

Problem 6. Answer

a. Below, the preferences for Person 1 and Person 2 are drawn. Same procedure is used for the other three people.



b. C wins in every pairwise vote. Thus, there is a stable majority outcome, despite the fact that persons 1, 2, and 3 have double-peaked preferences. This demonstrates that although multi-peaked preferences *may* lead to voting inconsistencies, this is not necessarily the case.

Problem 7.
Consider a society with three people (John, Eleanor, and Abigail) who use majority rule to decide how much money to spend on schools. There are three options for spending on a public park: H (high), M (medium), and L (low). These individuals rank the three options in the following way:

Rank	John	Eleanor	Abigail
1	M	L	H
2	L	M	M
3	H	H	L

a. Consider all possible pairwise elections: M versus H, H versus L, and L versus M. What is the outcome of each election? Does it appear, in this case, that majority rule would lead to a stable outcome on spending on the public park? If so, what is that choice? Would giving one person the ability to set the agenda affect the outcome? Explain.
b. Now suppose that Eleanor's preference ordering changed to the following: first choice = L, second choice = H, and third choice = M. Would majority rule lead to a stable outcome? If so, what is that choice? Would giving one person the ability to set the agenda affect the outcome? Explain.

Problem 7. Answer

a. The outcome of the first election (M vs. H) is M. The outcome of the second election (H vs. L) is L. The outcome of the third election (L vs. M) is M. Majority rule leads to a stable outcome since M defeats both H and L. Giving one person the ability to set the agenda would not affect the outcome in this case.

b. With the change in Eleanor's preference ordering, majority rule no longer generates a stable outcome. In a vote between M and H, the outcome is H. In a vote between H and L, the outcome is L. In a vote between L and M, the outcome is M. So, giving one person the ability to set the agenda affects the outcome. For example, Abigail prefers H, so she might pit L against M first in order to eliminate L and avoid having L defeat H.