

EXTERNALITIES**Problem 1**

The private and social marginal cost functions (MPC and MSC, respectively) are given by $MPC(q) = MSC(q) = 10 + 3q$, where q stands for the output quantity. The private and social marginal benefit functions (MPB and MSB, respectively) are: $MPB(q) = 70 - 2q$, $MSB(q) = 70 - q$.

- Depict the situation in a graph.
- To correct the inefficient market allocation, should a Pigouvian tax or a Pigouvian subsidy be introduced? What should be the value of the Pigouvian tax/subsidy?

Problem 2

A milk dairy is located close to an airport. The total revenue of the airport is $TR_A(A) = 48A$, while the total cost is $TC_A(A) = A^2$, where A is the daily number of airplanes landing. The total revenue of the dairy is $TR_D(C) = 60C$, while the total cost is $TC_D(C) = C^2 + CA$, where C is the number of cows (in hundreds). Notice that the nearby localization of the airport generates a negative externality for the dairy.

- a) Suppose both enterprises maximize profits and there is no legal restriction addressing the negative effects of the airport's activity on its surroundings. Assume also that no agreement is possible between the airport and the dairy concerning the number of airplanes landing. How many cows would the dairy have, and how many planes per day would land at the airport? Find the total profit for each enterprise.
- b) Find the Pigouvian tax rate correcting the inefficient market allocation described in point a). How many cows would then be kept by the dairy, and how many airplanes would land? Find the total profits of the enterprises for this case.
- c) Assume there is a law that the airport must fully compensate for the dairy's loss of profits caused by the negative externality. How many cows would then be kept by the dairy, and how many airplanes would land? Compare the total profits of both enterprises in this case with the socially optimal outcome.
- d) Assume that both enterprises are able to agree on the number of landing airplanes and assume that the airport has a right to operate and generate the externality. Find the compensation amount that the dairy should offer to the airport in order to maximize its profits. How many cows would then be kept by the dairy, and how many airplanes would land? Find the total profits of both enterprises.

Problem 3

In a certain city, every morning, 6,000 residents need to commute from the southern residential district to the northern one, where they work. All of them go by car. They may choose to drive through the city center (Road 1) or use the beltway (=ring road) (Road 2). Road 2 is longer than Road 1, but it is never congested. By the beltway (Road 2), it takes 45 minutes to drive from the southern to the northern district. The driving time (t , in minutes) on Road 1 depends on the traffic and is given by $t = 20 + n/100$, where n is the number of road users.

- a) In equilibrium, how many people use Road 1?
- b) For the equilibrium outcome, how much time do residents of the southern district altogether spend driving from the south to the north each morning?
- c) You are hired as an expert to determine the maximum number of persons that should use Road 1 to minimize the total time spent driving in the morning by all southern district residents.
 - What is that number?
 - How long will it take now to drive to the north using Road 1?
 - How much time will residents of the southern district altogether spend now driving from the south to the north?

- d) Based on economists' calculations, the value of time spent driving has been estimated to be 30 cents per minute. To minimize the total driving time of all residents of the southern district, driving on which road should be subject to a fee, and what should the fee be?
- e) When a fee from point d) is introduced, who will bear the costs of it? Does the answer depend on the way the revenue from the fee is distributed between the residents?