

ECN 275/375 – Natural resource and environmental economics
12:15-15:15 March 7, 2025

All help aids allowed except assistance from others.

This test consists of three 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 artificial intelligence (AI) . If AI use is detected beyond reasonable doubt, unreported use leads to a score of zero. Students can use AI if they self-report such use on specific questions at a cost: A question with self-reported AI use reduces the score by 40%.

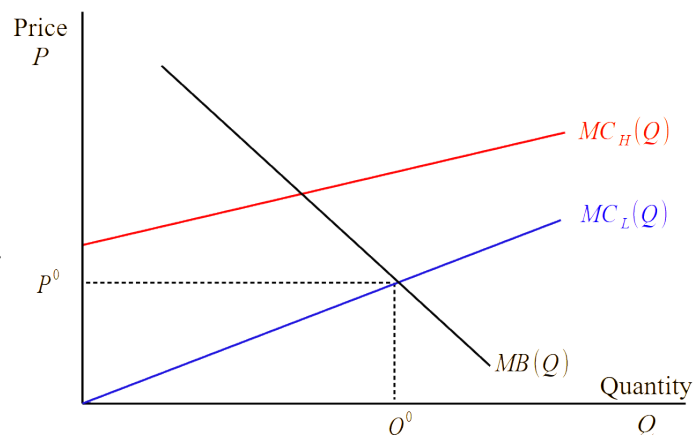
When I submit my answers on this test, I confirm that I have worked alone on my answers and not cooperated with others. I am aware that cooperation with others is considered an attempt or a contribution to cheating.

I am aware of the consequences of cheating (cfr. 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 two firms, L and H, each with marginal costs of producing a public good Q equal to $MC_L(Q)$ and $MC_H(Q)$. $MB(Q)$ represents the marginal benefits of the public good. Its optimal quantity is Q^0 with the existing production costs. It is paid for by a government subsidy to producers equal to P^0 such that total tax outlays are $T^0 = P^0 Q^0$. The figure to the right illustrates the situation:

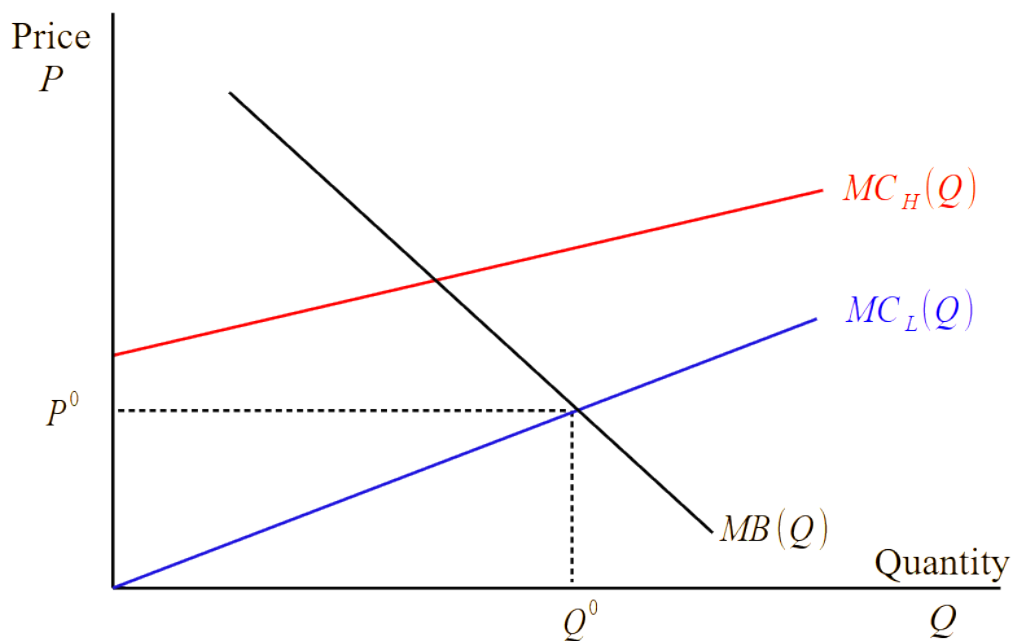


- (a) (i) Explain why the cost effective distribution of the optimal production quantity Q^0 is that the H firm produces $Q_H = 0$, and the L firm produces $Q_L = Q^0$.
- (ii) Explain why this does not conflict with the standard definition of cost effectiveness that marginal costs should be equal at their chosen production levels. What is the situation in the figure called?

Answer: (i) write here

(ii) write here

- (b) Suppose the government wonders if consumer welfare would increase if it pays the investment costs of firm H so it can lower its marginal costs to become recipients of the production subsidy. Draw a situation with lower marginal costs of firm H in the figure below – a copy from part (a), and explain what happens.



Answer: write here (use the figure above to the directly draw with the PC-tools you have, or make your own)

- (c) What is the condition for such investments in year zero to be welfare enhancing for the households in a country?

Answer: write

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

The basic equation for monitoring and enforcement (ME) can be written as $\rho \geq \frac{\pi_N - \pi_C}{S}$,

where ρ is the minimum monitoring probability to secure compliance,

π_N is the agent's payoff under non-compliance,

π_C is the agent's payoff under compliance, and

S is the penalty when monitored and caught in violation (non-compliance).

- (a) The above expression implies that the necessary monitoring probability, ρ , needs to increase when the agent gains more from non-compliance (cheating) compared to compliance, i.e. $\pi_N - \pi_C$ grows with the size of the violation, v .
- (i) To monitor agents, the regulator needs to be able to observe the size of the violation, v . What property must the penalty function $S(v)$ have to address this concern?
- (ii) Other concerns include that the regulator spends too much time pursuing minor violations, and that losses to society grow proportionally more than the size of the violation. Give an example of a penalty function that addresses these concerns? Briefly explain your reasoning behind this penalty function.

Answer: (i) write here

(ii) write here

- (b) In the reputation based model habitual non-compliers must pay a monitoring fee, M , whenever monitored, while habitual compliers do not because they are under a different set of rules. This changes the equation for compliance to:

$$\rho \geq \frac{\pi_N - \pi_C}{S + M}$$

- (i) Using the above expression, explain why this reduces the necessary monitoring probability, ρ , in the reputation based model compared to the basic model. What is this effect called? (ii) Set up the expression for arriving at the above condition, and explain your reasoning behind this expression.

Answer: (i) write here

(ii) write here

- (c) From your starting expression in (b-ii) show how you arrive at the stated modification of the necessary monitoring probability to provide incentives for compliance.

Answer: write here

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

Three of the most notable negative externalities from using cars as a means of transportation are:

- i. Greenhouse gas (GHG) emissions, though only from fossil fuel powered vehicles, hereafter FV.
- ii. Particulate matter due to wear from roads and tires.
- iii. Congestion which increases the risk of accidents and makes travel more time consuming during peak traffic hours.

The setting is like Norway, i.e. the electric vehicle (EV) share of new private cars sold is about 90%. You, an expert in environmental economics, are asked to comment on the government plans to develop a more coherent environmental policy for private cars aiming to reduce the above three externalities from private (household) transport.

- (a) One of the proposals is to increase the fossil fuel taxes to reduce the kilometers driven by private cars to lower all of the three mentioned externalities. Comment on the **weak sides** of this proposal.

Answer: write here

- (b) The Ministry of finance supports the introduction of higher fuel taxes as it makes it easier to lower or abolish the current subsidies for buying EVs. (i) Explain the conditions that need to be in place for upholding or increasing the share of new EVs sold. (ii) Which are the other major expected benefits of replacing subsidies for buying EVs with fossil fuel taxes? For each major benefit you list, explain why this is a benefit to society.

Answer: (i) write here

(ii) write here

- (c) The government also considers implementing road pricing. Road pricing means that each vehicle is tracked in terms of where and when. Based upon distance driven, the weight of the vehicle, and the time of driving when congestion is an issue, drivers are charged accordingly. (i) Explain how road pricing will impact the three externalities mentioned. (ii) What are the main obstacles against introducing road pricing. Briefly comment on those objections, and how concerns about these objections can be met.

Answer: (i) write here

(ii) write here

- (d) *Tinbergen's rule* implies that **to achieve multiple policy targets, one needs one policy instrument per target to reach the target**. The rule originates from macroeconomics, but has been useful for all types of regulation.

Explain how the *Tinbergen rule* aligns (is consistent) with your answer on (c). If you think your answer in (c) is inconsistent with the Tinbergen rule, explain how you would modify your answer in (c).

Answer: write here