

## Practice Set 6

### Market Failure & Government Intervention

This set contains problems for your own practice. Do not just read the provided solutions — try to solve the problems first, and use the solutions only when you are stuck. Reading solutions without attempting the problems first has the same value for your preparation as watching someone else run a marathon and then expecting to be able to run it yourself. If you are unable to comprehend the solution of a problem even after reading the instructional answer key, you have most likely missed the relevant part of the material underlying this problem. Direct any questions about this problem set to your section's teaching assistant.

- Consider the monopoly illustrated in *Figure 1*. A regulator considers 4 alternative price ceilings:  $p_1$ ,  $p_2$ ,  $p_3$  and  $p_4$ .
  - Would the imposition of  $p_1$  improve efficiency in this market?
  - Explain why  $p_2$  would maximize efficiency in this market.
  - Would the imposition of  $p_4$  make the monopolist produce at minimum average cost?
  - Would the imposition of  $p_3$  make the monopolist produce the quantity that corresponds to point F?
  - Is the monopoly in figure 1 a natural monopoly?

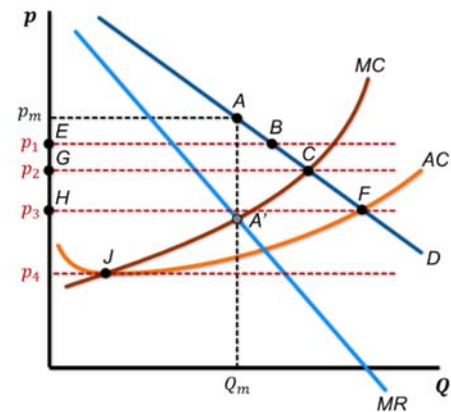


Figure 1

- Consider the monopoly illustrated in *figure 2*. A regulator considers 2 alternative price ceilings:  $p_1$  and  $p_2$ .
  - Explain why this is a natural monopoly.
  - Which price ceiling should be imposed to maximize efficiency in this market?
  - Which price ceiling should the regulator impose in order to maximize production, while the monopoly can still be sustainable on its own?

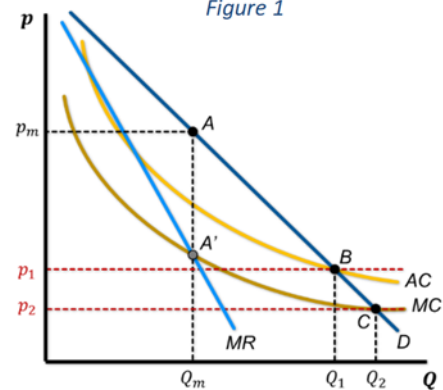


Figure 2

- Production of electricity in a town requires total cost  $TC = 600 + 10Q$  and marginal cost  $MC = 10$ . The town's demand for electricity is  $p = 90 - 2Q$ .
  - Derive the price, output and profit if the electricity market is a *monopoly*.
  - Derive the price, output and profit if the electricity market is a *collusive duopoly*.
  - Derive the price, output and profits if the market of electricity is a *Cournot duopoly*.
  - What kind of industry is this?
  - Derive the price, output and profits if the electricity market is *regulated* so that  $p = MC$ .
  - Derive the price, output and profits if the electricity market is *regulated* so that  $p = 30$ . What kind of regulation is this?
- Olga has the right to choose between two plans: Plan A that awards \$10 to her and \$10 to George; and Plan B that awards \$11 to her and \$1 to George. Both Olga and George only care for their individual payoff.
  - Predict the outcome of this scenario.
  - Calculate the DWL.
  - Explain how a regulator can eliminate the DWL by taxing the party that gains from the intervention and using it to compensate the other party.

5. MeatMe, a barbecue restaurant, opened next to the Vegan Café. The barbecue smell from MeatMe bothers patrons sitting on the Vegan Café's patio, and the owner anticipates a \$200k loss in profits. While MeatMe could install proper ventilation to eliminate the odor, it sees no direct benefit in doing so.
- (a) How could this externality be resolved if the cost of the ventilation system exceeds \$200k?
  - (b) How could this externality be resolved if the cost of the ventilation system is less than \$200k?

# Answer Key

1. Consider the monopoly illustrated in Figure 1. A regulator considers 4 alternative price ceilings:  $p_1$ ,  $p_2$ ,  $p_3$  and  $p_4$ .

- (a) Would the imposition of  $p_1$  improve efficiency in this market?

*It would. Without regulation the monopolist would charge  $p_m$ , causing a DWL equal to the area  $AA'C$ . If a price ceiling is imposed at  $p_1$ , the monopolist would bring the price down to  $p_1$  and sell more than  $Q_m$ , decreasing the DWL.*

- (b) Explain why  $p_2$  would maximize efficiency in this market.

*Implementing a price ceiling at  $p_2$  brings the monopolist to point C, where  $p = MC$  — the PC outcome. DWL is completely eliminated, so efficiency is maximized. At  $p_2$  the monopolist earns a positive profit, since  $p_2$  is above AC at point C. This makes regulation at  $p_2$  sustainable — no subsidy is needed to keep the monopolist operating.*

- (c) Would the imposition of  $p_4$  make the monopolist produce at minimum average cost?

*It would. This, however, would dramatically reduce output, resulting in a large DWL.*

- (d) Would the imposition of  $p_3$  make the monopolist produce the quantity that corresponds to point F?

*It would not. If price ceiling  $p_3$  were imposed, the monopolist would not produce at point F, where  $p_3 = AC$  and profit is zero. Instead, the monopolist would produce at  $p_3 = MC$ , where  $p_3 > AC$  and profit is positive.*

- (e) Is the monopoly in figure 1 a natural monopoly?

*No, it is not. This monopoly operates under diseconomies of scale even for quantities as low as the quantity that corresponds to point J. This means that splitting production among multiple firms could decrease the per-unit cost.*

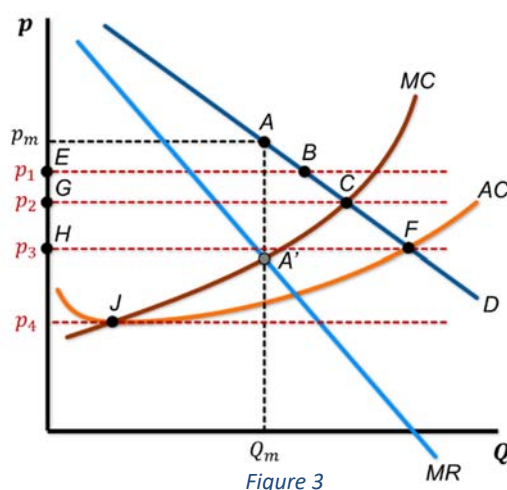


Figure 3

2. Consider the monopoly illustrated in figure 2. A regulator considers 2 alternative price ceilings:  $p_1$  and  $p_2$ .

- (a) Explain why this is a natural monopoly.

*This is a natural monopoly because AC is decreasing throughout the entire range of quantities covered by the demand curve. This means any given quantity can be produced at a lower AC by a single firm than by splitting production among multiple firms (which would replicate the same AC and MC curves).*

- (b) Which price ceiling should be imposed to maximize efficiency in this market?

*Maximum efficiency requires  $p = MC$ . A price ceiling at  $p_2$  would bring the monopolist to point C, achieving this outcome. However, at  $Q_2$  the monopolist incurs losses, making  $p_2$  unsustainable without government support. The monopolist will only continue operating at  $p_2$  if the regulator covers its losses through a subsidy.*

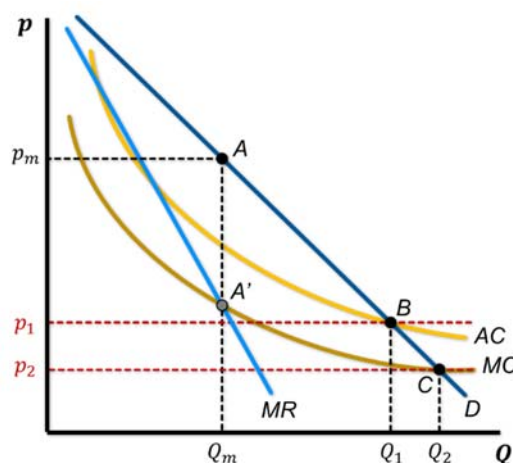


Figure 4

- (c) Which price ceiling should the regulator impose in order to maximize production, while the monopoly can still be sustainable on its own?

*A price ceiling at  $p_1$  leads the monopolist to produce  $Q_1$  where  $p = AC$  and profit is zero — the monopolist breaks even and produces more than the unregulated monopoly quantity  $Q_m$  but less than if it were regulated at  $p_2$ . However, DWL is not fully eliminated and efficiency is not maximized.*

3. Production of electricity in a town requires total cost  $TC = 600 + 10Q$  and marginal cost  $MC = 10$ . The town's demand for electricity is  $p = 90 - 2Q$ .

- (a) Derive the price, output and profit if the electricity market is a *monopoly*.

*$MR = 90 - 4Q$ . Setting  $MR = MC$ :  $90 - 4Q = 10$ , so  $Q = 20$ . From the demand curve:  $p = 90 - 2 \cdot 20 = 50$ . Profit:  $\Pi = p \cdot Q - TC = 50 \cdot 20 - 600 - 10 \cdot 20 = 200$ .*

- (b) Derive the price, output and profit if the electricity market is a *collusive duopoly*.

*The monopoly quantity is split equally:  $q_1 = q_2 = 10$ . The market price remains  $p = 50$ . Profit for firm 1 is  $\Pi_1 = p \cdot q_1 - TC_1 = 50 \cdot 10 - 600 - 10 \cdot 10 = -200$ . Equally,  $\Pi_2 = -200$ . The duplication of fixed costs makes production unprofitable — market demand is insufficient to support two firms.*

- (c) Derive the price, output and profits if the market of electricity is a *Cournot duopoly*.

*Under Cournot duopoly, firms produce more than under collusion — let us check whether this makes them profitable. Demand is  $p = 90 - 2q_1 - 2q_2$ .  $MR_1 = 90 - 2q_2 - 4q_1$ . Setting  $MR_1 = MC$ :  $90 - 2q_2 - 4q_1 = 10$ , so  $q_1 = (80 - 2q_2)/4$ . Assuming symmetry for the two firms:  $q_1 = q_2$ , so  $q_1 = (80 - 2q_1)/4$  or  $4q_1 = 80 - 2q_1$  or  $q_1 = q_2 = 13.\bar{3}$ . From the demand curve:  $p = 90 - 2(13.\bar{3} + 13.\bar{3}) = 36.\bar{6}$ . Profit:  $\Pi_1 = p \cdot q_1 - TC_1 = 36.\bar{6} \cdot 13.\bar{3} - 600 - 10 \cdot 13.\bar{3} = -244.\bar{4}$ . Equally,  $\Pi_2 = -244.\bar{4}$ . Higher quantities reduce AC but the lower price is insufficient to cover costs.*

- (d) What kind of industry is this?

*This is a natural monopoly — the industry is only viable with a single firm. The high fixed costs (600) require sufficiently large output for AC to fall below the price consumers are willing to pay, as given by the demand curve.*

- (e) Derive the price, output and profits if the electricity market is *regulated* so that  $p = MC$ .

*Setting  $p = 10$ :  $10 = 90 - 2Q$ , so  $Q = 40$ . Profit:  $\Pi = p \cdot Q - TC = 10 \cdot 40 - 600 - 10 \cdot 40 = -600$ . Efficiency is maximized and quantity is higher than under any other scenario, but the monopoly must be subsidized by 600 monetary units per period to remain viable.*

- (f) Derive the price, output and profits if the electricity market is *regulated* so that  $p = 30$ . What kind of regulation is this?

*Setting  $p = 30$ :  $30 = 90 - 2Q$ , so  $Q = 30$ . Profit:  $\Pi = p \cdot Q - TC = 30 \cdot 30 - 600 - 10 \cdot 30 = 0$ . Quantity is lower than under maximum efficiency regulation, but the monopoly is self-sustaining. This is  $p = AC$  regulation.*

4. Olga has the right to choose between two plans: Plan A that awards \$10 to her and \$10 to George; and Plan B that awards \$11 to her and \$1 to George. Both Olga and George only care for their individual payoff.

- (a) Predict the outcome of this scenario.

*Olga would choose Plan B because it yields a higher payoff for her. She would receive \$11 and George would receive \$1.*

- (b) Calculate the DWL.

*Plan B allocates only \$12 in total, while plan A allocates \$20 in total. The DWL is  $20 - 12 = \$8$ .*

- (c) Explain how a regulator can eliminate the DWL by taxing the party that gains from the intervention and using it to compensate the other party.

*The regulator can make George pay \$1 tax and give it to Olga in exchange for choosing plan A instead of plan B. George's payoff would be  $\$10 - \$1 = \$9$ , which is better than the \$1 he would receive otherwise. Olga's payoff would be  $\$10 + \$1 = \$11$ , which is the same she would receive under plan B. Neither George nor Olga have a reason to oppose the intervention.*

5. MeatMe, a barbecue restaurant, opened next to the Vegan Café. The barbecue smell from MeatMe bothers patrons sitting on the Vegan Café's patio, and the owner anticipates a \$200k loss in profits. While MeatMe could install proper ventilation to eliminate the odor, it sees no direct benefit in doing so.

- (a) How could this externality be resolved if the cost of the ventilation system exceeds \$200k?

*The Vegan Café will not pay more than \$200k to solve a problem that costs it \$200k. Since the ventilation system costs more than \$200k, the cure is more expensive than the damage — the externality cannot be resolved through negotiation.*

- (b) How could this externality be resolved if the cost of the ventilation system is less than \$200k?

*The Vegan Café could offer to cover the installation cost. However, MeatMe could act opportunistically and demand more than the actual installation cost. If, for instance, the system costs \$100k, MeatMe could demand \$150k. The Vegan Café would still be willing to accept — it resolves a \$200k loss for only \$150k. Depending on the relative bargaining power of the two firms, the Vegan Café could end up paying anywhere between \$100k and \$200k.*

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Please report any typos, mistakes, or suggestions for improvement to [kmarinakis@smu.edu.sg](mailto:kmarinakis@smu.edu.sg).