ECON3133 Midterm Exam

Fall 2020, 80 minutes, 100 points

There are 4 questions.

1. (25 points) The total cost of a generic face mask firm (production line) is

$$C(q) = 100 + 4q^2,$$

where q is packages of face masks. Before the pandemic, there is only one face mask firm in Hong Kong.

a. Suppose the firm is a price-taker. The price for each package of face masks is p. What is the firm's short-run supply function $S_i(p)$?

b. What is the minimum price (p_0) that can make this firm breakeven in the long run? What is the minimum efficient scale (q_{min}) of the firm?

c. To fight against COVID-19, Hong Kong government offers funding for firms to set up new face mask production lines (www.hkpc.org/en/our-services/additive-manufacturing/latest-information/hkpc-mask-production-support).

Suppose that there are another 15 face mask firms established. What is the industry supply function with $n = 16$ firms? All these firms have the same technology and are price-taking.

d. Continue with part (c). The market demand is $Q_D(p) = 300-3p$. Find the equilibrium price and quantity.

e. Continue with part (d). If the government wants to bring the face mask price down to $p^* = 50$ per package, how many face mask firms in total need to be established? All firms have the same cost function.

f. In the **long run**, there is no entry barrier to the face mask industry. All firms have the same production technology as above. The market demand is $Q(p) = 300 - 3p$. What is the long-run equilibrium of this market?

g. In the **long run**, to lower face mask price, the government provides $s = 5$ per package subsidy. Specifically, consumers pay p_D per package. Firms earn p_S per package. In equilibrium, $p_D + s = p_S$. Predict the total amount of subsidy the government will need to pay. The market demand is $Q(p) = 300 - 3p$.

2. (25 points) A monopoly firm faces a market with demand function

$$q(p) = \alpha p^{\beta}, \quad \text{where } \beta < -1.$$

The cost function of the firm is

$$C(q) = c \times q + 4,$$

so it has a constant marginal cost c.

a. The firm chooses quantity q to maximize its profit. Express the total revenue and marginal revenue as functions of q.

b. Given α, β, and c, find the optimal choice of quantity q^* and price p^*.

c. Let $\beta = -2$, $\alpha = 48$, $c = 2$. Compute the firm's profit π and consumer surplus CS.

d. The average cost of the monopoly firm is decreasing in q, so this industry is a natural monopoly. Consider that the government wants to regulate the price. What is the price that maximizes total surplus? What is the lump-sum subsidy that the government should pay the monopoly to maintain a zero profit in the long run?

e. What is the problem of having a non-price-taking firm and an inelastic demand? Suppose that $-1 < \beta < 0$, show that the monopoly's profit-maximizing behavior would be strange.

3. (20 points) The supply of cigarettes is represented by $S(P, v) = 2Pv^{-2}$, where P is price of cigarette, v is the price of tobacco. Tobacco is a key raw material for cigarette production.

The demand of cigarette is represented by $D(P, I)$, where I is the income of a representative consumer. The policymaker does not know the entire demand curve but knows that the (local) price elasticity $e_{D,P} = -0.5$ and income elasticity $e_{D,I} = 1.5$.

a. Compute $e_{S,P}$ and $e_{S,v}$. Is the demand of cigarette demand price elastic or inelastic? Cigarette is a luxury good or necessity?

b. If income I increases by 10%, how much will the equilibrium price of cigarette change?

c. The government wants to reduce cigarette consumption by charging extra tax on the usage of the key input, tobacco. Roughly predict that, if the government charges a 12% tax on tobacco (raise v by 12%), how much will the equilibrium price of cigarette rise?

d. The government charges a per unit tax t on cigarette consumption. Roughly predict what proportion of this tax t is born by consumers.

e. Suppose the current equilibrium price and quantity is $P = 10$ and $Q = 100$. A per-unit tax $t = 1$ is imposed on cigarette. Predict the deadweight loss caused by this tax.

4. (20 points) There are two firms in a town, A and B. Both of them use capital (machine) k and labor l to produce outputs. Firm A is a toy manufacturer with the production function

$$q = f_A(k, l) = \sqrt{k}\sqrt{l}.$$

Firm B is a textile manufacturer with production function

$$y = f_B(k, l) = \sqrt{k} + \sqrt{l}.$$

q and y denote the quantity of toys and textiles, respectively. The output markets of toys and textiles are independent. q and y are given exogenously to these firms. Let v denote the unit price of capital and w denote the unit price of labor. Both firms are cost-minimizing.

a. What are the elasticity of substitution of firm A and firm B, σ_A and σ_B?

b. The government launches an industrial policy that supports workplace automation. The policy gives subsidies to firms for using machines. As a result, the relative price of labor to capital increases by 20%. Without specifying particular values of v, w, q and y, can you predict how will the capital-labor ratio (k/l) change in the two firms? That is, report the percentage change of k/l after raising w/v by 20%.

c. Let the input prices be $w = 5$ and $v = 5$. Fix the output levels at $q = 10$ and $y = 10$. Compute the (contingent) capital and labor demands of the two firms.

d. Continue with part (b) and (c). Continue to fix $q = 10$ and $y = 10$. The workplace automation policy \$1 subsidy for using machines, so the new input prices are $w = 5$ and $v = 4$. Compute the (contingent) capital and labor demands of the two firms.

e. Based on your results above, discuss the impacts of the workplace automation policy. You can choose two aspects below for discussion.

(i) Does the policy hurts workers?

(ii) How the policy affect the two industries differently? Why?

(iii) Is the policy likely to increase inequality of the society?

(iv) Can you think about any reason that the government should promote the policy?

(v) Other impacts you can think of.