Oliver Berg

A10282W1

COLLECTION PAPER

Honour School of Philosophy, Politics and Economics
Honour School of Economics and Management
Honour School of History and Economics

INTRODUCTORY ECONOMICS (Microeconomics)

MICHAELMAS TERM 2024

Total time allowed: $1\frac{1}{2}$ hours

There are 3 questions in this paper.

Candidates must answer **two** *questions.*

All questions attract the same number of total marks. For multipart questions, the weight assigned to each part is indicated in square brackets.

1. Consider a perfectly competitive industry supplied by a number of identical firms. Each firm in the industry has a cost function given by $c(q) = q^2 + F$ where q is the firm's output and $F > 0$ is its fixed cost. There is free entry and exit of firms, and firms are price-takers. The number of firms in the industry is denoted by n, and total supply is $Q = nq$. The market demand curve for this industry is $Q = D - P$, where $D > 0$ is a parameter representing the strength of demand, Q is the total quantity demanded and P is the price.

(a) Show that in equilibrium each firm in the industry supplies $\sqrt{F}$ and that the equilibrium price is $2\sqrt{F}$. Explain why the demand parameter, D, does not affect the equilibrium price when firms can enter and leave the industry freely. [15%]

(b) If fixed costs are 100, calculate the output per firm and the equilibrium price. If $D = 200$ and fixed costs are 100 how many firms are there in the industry? Calculate the price elasticity of demand and consumer surplus at the equilibrium price. [15%]

A shock hits demand, with D falling to 180. The fixed costs remain at 100.

(c) What are the effects of the demand shock on the equilibrium number of firms and on the price elasticity of demand? [10%]

The government now decides, in the interests of competition, to keep the number of firms fixed at the level that applied in part (b) instead of allowing the number of firms to adjust in response to the demand shock. Two alternative policies are available: a subsidy that reduces the price consumers pay so the total quantity bought is the same as before the shock, and a lump-sum subsidy to firms to help them to cover their fixed costs.

(d) The government uses the consumer price subsidy. Calculate the price that consumers should pay, consumer surplus and the total cost of the subsidy. [20%]

(e) Now suppose that instead the lump-sum subsidy for firms is used. Calculate the price, total output, consumer surplus, the level of subsidy per firm and the total cost of the subsidy. [20%]

(f) Which of the two policies would you recommend that the government uses to achieve its objective of keeping the number of firms fixed? Explain the reasons for your recommendation. [20%]

2. Two individuals (denoted 1, 2 respectively) are deciding how much of a private and a public good (denoted x, g respectively) they want to consume/provide. They have identical preferences given by

$$u(x_i, g) = 2\log(x_i) + \log(g)$$

where g denotes the level of the public good and x_i denotes individual i's consumption of the private good. Each contributes g_i to the provision of the public good so total provision is the sum $g = g_1 + g_2$. They both have an income of 100 and the prices of both public and private goods are 1.

(a) Derive each individual's best-response public good contribution as a function of the other's contribution. [30%]

(b) Find the Nash equilibrium of this game. [10%]

(c) Compare the level of public good provision in the Nash equilibrium with the socially optimal level. What is the reason for this difference and where is that reason manifest in the model? [20%]

(d) The government decides to levy a poll tax of 5 on each person to help finance the public good. What happens to the overall level of provision? [20%]

(e) What general conclusions can you draw regarding public good provision from the preceding exercises? [20%]

3. EITHER

The concept of Nash equilibrium is often used as a guide to help predict how economic agents will behave in strategic interactions. Why?

OR

Explain the notion of "signalling" as a solution to informational problems in markets.

1/2

Q1 80
Q2 77
79

outstanding I

MERTON COLLEGE

COLLECTION PAPER

Please complete in BLOCK CAPITALS

Full name	Honour School
OLIVIER BERG	PPE
Term of collection	**Title of collection**
HT	Microeconomics
Tutor marking the collection	
Bosser Harbosh	

Attach securely to this booklet any loose sheets or supplementary books

1) a. In the long run, under perfect competition, profit will be 0. Therefore, the price is equal to the AC and also equal to MC.

10

Yes — this follows from $\pi = 0$.

This does not follow from $\pi = 0$. It follows from profit maximization!

$$MC = 2q \qquad AC = \frac{q^2 + F}{q} = q + \frac{F}{q}$$

$$MC = AC$$

$$2q = q + \frac{F}{q}$$

$$q = \frac{F}{q}$$

$$q = \sqrt{F} \quad \text{(no negative solutions possible)}$$

and as

$$P = MC \quad (\text{~~perfect competition~~ profit max})$$

$$P = 2q = 2\sqrt{F}$$

~~D will only effect the amount of firms in the market because~~

D does not affect long-run market price due to free entry & exit. Long-run market price will depend only on firms' cost structure.

(12)

B. $F = 100$

$q = \sqrt{F} = \sqrt{100} = 10$ ✓

$P = 2\sqrt{F} = 20$ ✓

$\boxed{Q_S = Q_D}$ — In words, "In eq. supply = demand, hence"...

8

$nq = D - P$

$10n = 200 - 20$

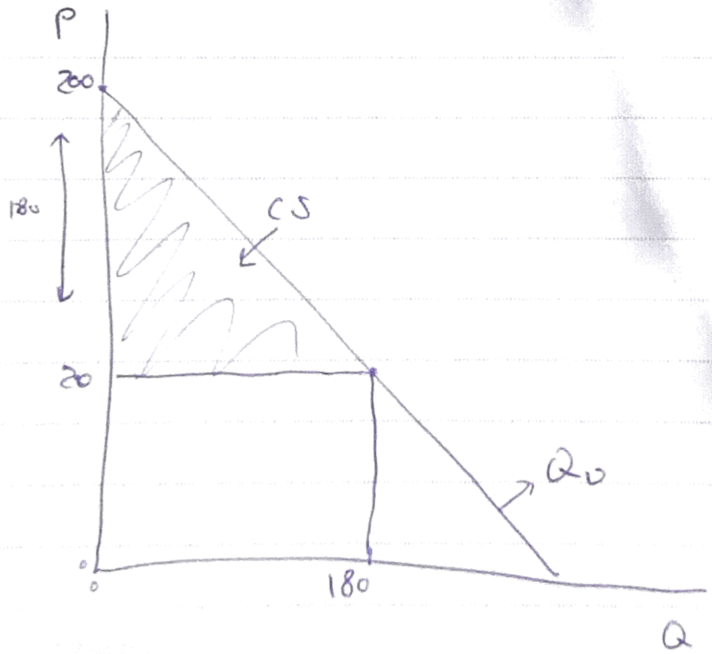
$n = 18$ ✓

$Q_S = 18q = 180$

$\varepsilon = \frac{\partial Q_D}{\partial P} \frac{P}{Q} = -1 \cdot \frac{20}{180} = -\frac{1}{9}$ ✓

• $Q_S = 18q = 180$ and $P = 20$

$P_D = 200 - Q_D$



$CS = \frac{1}{2} \cdot 180 \cdot 180 = 16200$ ✓

words, say what this measures.

c.

7

$$Q_S = Q_D$$

$$nq = D - P$$

$$10n = 180 - 20$$

$$n = 16$$

$$Q_S = 164 = 160$$

$$\varepsilon = \frac{\partial Q_D}{\partial P}\frac{P}{Q} = -1 \cdot \frac{20}{160} = -\frac{1}{8}$$

ok and? Comment on your answer.
Is demand more or less elastic now?
Does the result make intuitive sense?

d. ~~the the demand has to be 180 of P=80. that means that the inverse demand curve has to shift up by~~ 180 - 160 = 20

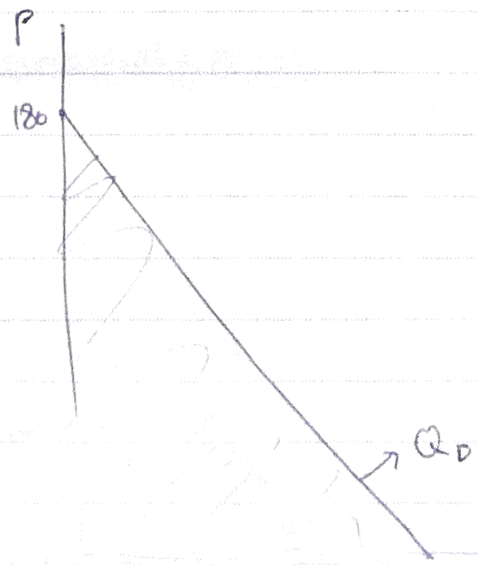
18

the demand has to be 180 at P = 20.
when ~~P=20, consumers~~ Q = 180 consumers are willing to pay: ~~180~~ 180 = Q_D = ~~160~~ 180 - P

$$\cancel{180}\ 0 = -P$$

$$P = \cancel{180}\ 0$$

so the price will have to go down by 20.
so consumers pay P=0, the total cost of the subsidy will be 180 · 20 = 3600



ok.

18

e. the lump-sum will need to offset cost of reducing prices to 0, so costs will need to be reduce:

$$C = q^2 + F - L \qquad (L = \text{lump-sum})$$
$$= q^2 + 100 - L$$

Again, same calculation as in Part a:

$$AC = \frac{q^2 + 100 - L}{q} \qquad MC = 2q$$

$$AC = MC$$

$$\frac{q^2 + 100 - L}{q} = 2q$$

very indirect but ok

$$q + \frac{100 - L}{q} = 2q$$

$$\frac{100 - L}{q} = q$$

$$q = \sqrt{100 - L} \quad \text{and} \quad P = 2\sqrt{100 - L}$$

~~as P = 0 and P = AC = MC~~

~~$0 = 2\cdot\sqrt{100 - L}$~~

~~$L = 100$~~

~~However, then $q = \sqrt{100 - 100} = 0$~~

$$Q_S = Q_D$$

$$= P - P$$

$$\sqrt{100-L} = 9$$

$$100 - L = 81$$

$$L = 19$$

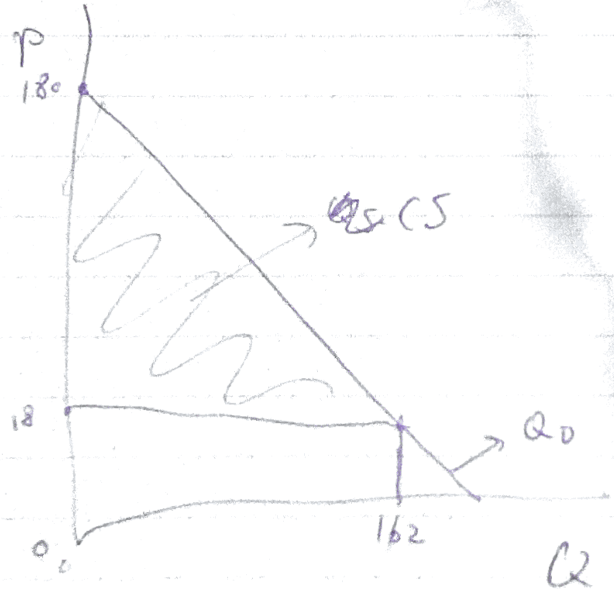
and so $q = \sqrt{100-19} = 9$

$$P = 2 \cdot 9 = 18$$

$$Q_S = 9 \cdot 18 = 162$$

ok

total cost of subsidy: $n \cdot L = 18 \cdot 19 = 342$



$$CS = \frac{1}{2}(180-18) \cdot 162 = 13122$$

So Higher welfare with the lump-sum, so the government should choose the lump-sum.

15

F. the firms are indifferent (profit is 0 in both cases). with the lump-sum tax, the price that consumers face is higher and their surplus is lower.
However the subsidy is very expensive for the

subsidy

$CS = 16200$

costs government $= 3600$

$16200 - 3600 = 12600$

$13122 - 342 = 12780$

(2) a $\max_{x_1, g_1} u_1 = 2\log(x_1) + \log(g_1 + g_2)$

s.t. $100 = 1 \cdot g_1 + 1 x_1 = g_1 + x_1$

30

$$\mathcal{L} = 2\log(x_1) + \log(g_1 + g_2) - \lambda(g_1 + x_1 - 100)$$

to optimize, set all partial derivatives to 0

$$\frac{\partial \mathcal{L}}{\partial x_1} = \frac{2}{x_1} - \lambda = 0$$

$$\frac{2}{x_1} = \lambda$$

$$\frac{\partial \mathcal{L}}{\partial x_2} = 1 \cdot \frac{1}{g_1 + g_2} - \lambda = 0$$

$$\frac{1}{g_1 + g_2} = \lambda$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = g_1 + x_1 - 100 = 0$$

$$g_1 + x_1 = 100$$

Rather than doing this, number or label your equations.

$$\frac{2/x_1}{1/(g_1+g_2)} = \frac{\lambda}{\lambda}$$

$$\frac{2x_1^{-1}}{1 \cdot (g_1+g_2)^{-1}} = 1$$

$$\frac{2}{} \quad \frac{1}{ + g_2}$$

$$3g_1 + 2g_2 = 100$$

$$g_1 = \frac{100}{3} - \frac{2}{3}g_2$$

As the individuals are identical, it is symmetric:

$$g_2 = \frac{100}{3} - \frac{2}{3}g_1$$

8 8. $g_1 = \frac{100}{3} - \frac{2}{3}g_2$ $\quad g_2 = \frac{100}{3} - \frac{2}{3}g_1$

Define Nash equilibrium

$$g_1 = \frac{100}{3} - \frac{2}{3}\left(\frac{100}{3} - \frac{2}{3}g_1\right)$$

$$g_1 = \frac{100}{3} - \frac{200}{9} + \frac{4}{9}g_1$$

$$\frac{5}{9}g_1 = \frac{100}{9}$$

$$g_1 = 20$$

as it is symmetric, $g_1 = g_2 = 20$

$$g_1 + x_1 = 100$$

$$20 + x_1 = 100$$

$$x_1 = 80$$

For late

16

c. If we merge the utilities and costs of the two individuals:

$$\max_{x_1, x_2, g_1, g_2} U_{merged} = 2\log(x_1) + 2\log(x_2) + \log(g) + \log(g)$$

$$= 2\log(x_1 x_2) + 2\log(g_1 + g_2)$$

s.t. $100 + 100 = g_1 + x_1 + g_2 + x_2$

As they are identical $x_1 = x_2$ and $g_1 = g_2$

lets call $x_1 = x_2 = x$

so the:

$$\max_{x, g} U_{merged} = 2\log(x^2) + 2\log(g)$$

$$= 4\log(x) + 2\log(g)$$

s.t. $200 = g + 2x$

This will work in this case --- but I would not do this in general — Solve it without this assumption — Or use the Samuelson condition

$$\mathcal{L} = 4\log(x) + 2\log(g) - \lambda(g + 2x - 200)$$

(set all partial derivatives to 0 to optimise)

$$\frac{\partial \mathcal{L}}{\partial x} = \frac{4}{x} - 2\lambda = 0$$

$$\frac{4}{x} = 2\lambda$$

$$\frac{\partial \mathcal{L}}{\partial g} = \frac{2}{g} - \lambda = 0$$

$$\frac{2}{g} = \lambda$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = g + 2x - 200 = 0$$

$$+ 2x = 200$$

(Pookler)

2/2

MERTON COLLEGE

COLLECTION PAPER

Please complete in BLOCK CAPITALS

Full name	Honour School
OLIVIER BERG	PPE

Term of collection	Title of collection
HT	Microeconomics

Tutor marking the collection
Basset Farbush

Attach securely to this booklet any loose sheets or supplementary books

~~The~~

$$\frac{4/x}{2/y} = \frac{2\lambda}{\lambda}$$

~~EX~~

$$\frac{4/x}{2/y} = 2$$

$$\frac{4}{x} = \frac{4}{y}$$

$$x = y$$

$\cancel{x + 2x = 200}$

$\cancel{3x = 200}$

$$y + 2y = 200$$

$$3y = 200$$

$$y = \frac{200}{3}$$

✓ OK

$$x = g = \frac{200}{3}$$

so $U_{merged} = 4\log\left(\frac{200}{3}\right) + 2\log\left(\frac{200}{3}\right)$
$\approx 25.198...$

$U_{Nash, total} = 4\log(80) + 2\log(20+20)$
$\approx 24.905...$

So U_{merged} leads to a better outcome than the Nash equilibrium.
The reason for this is that g is a public-good. Therefore, if one of the players contributes a lot too it, the other player will be better off if they don't contribute as much and instead free-rides on the contributions of the other. This will make it into a prisoners dilemma so that eventually both players are worse off.

d. $\max_{x_1, g_1} U_{tot} = 2\log(x_1) + \log(5 + g_1 + g_2)$

The govt collects 5 from each player and uses that to buy 10 units of the public good.

10

1/3

S.t. $g_5 = g_1 + x_1$

$$L = 2\log(x_1) + \log(5 + g_1 + g_2) - \lambda(g_1 + x_1 - g_5)$$

(set all partial derivatives to 0 to optimise)

$$\frac{\partial L}{\partial x_1} = \frac{2}{x_1} - \lambda = 0$$

$$\frac{2}{x_1} = \lambda$$

error carried over but otherwise seems ok

$$\frac{\partial L}{\partial g_1} = \frac{1}{5 + g_1 + g_2} - \lambda = 0$$

$$\frac{1}{\quad g_2} = \lambda$$

$$\frac{\partial L}{\partial X} = g_1 + x_1 - 95 = 0$$

$$g_1 + x_1 = 95$$

$$\frac{2/x_1}{1/(5+g_1+g_2)} = \frac{\lambda}{\lambda} = 1$$

$$\frac{2}{x_1} = \frac{1}{5+g_1+g_2}$$

$$x_1 = 2(5 + g_1 + g_2)$$

$$g_1 + 2(5 + g_1 + g_2) = 95$$

$$3g_1 + 2g_2 + 10 = 95$$

$$3g_1 + 2g_2 = 85$$

$$g_1 = \frac{85}{3} - \frac{2}{3} g_2$$

it is symmetric again!

$$g_2 = \frac{85}{3} - \frac{2}{3} g_1$$

$$g_1 = \frac{85}{3} - \frac{2}{3}\left(\frac{85}{3} - \frac{2}{3} g_1\right)$$

$$g_1 = \frac{85}{3} - \frac{170}{9} + \frac{4}{9} g_1$$

$$\frac{5}{9} g_1 = \frac{85}{9}$$

$$g_1 = 17$$

Symmetric so $g_1 = g_2 = 17$

So total provision has gone up!

$$y = 10 + g_1 + g_2 = 44 > 40$$

e. ~~As~~ Because public goods can very easily lead to market failure (Pareto-inefficient outcome) because it is succeptible to free-riding, ~~a~~ ~~govern~~

Government intervention is needed to achieve the Pareto-efficient level of provision. One way to do this can be forcing people to ~~pay~~ contribute through taxes.

(8)