AAE 215 – Introduction to Agricultural and Applied Economics (Spring 2020)

Midterm Exam 2 – Answer Key

April 7, 2020

Part I: Multiple-choice questions

1. C
2. D
3. A
4. C
5. A
6. B

Part II: Exercises

Question 1: *Profit-maximizing choices*

1.a)

Free answer. Student must state their differentiated product of choice and if the demand for this product is generally price-elastic or price-inelastic.

1.b)

Free answer. Graph must show the three curves: demand, MR, and MC.

1.c)

The MC curve increases with production when the firm has exhausted economies of scale and now has diseconomies of scale. In other words, when the firm exhibits decreasing returns to scale (increasing costs). Answers citing diminishing returns to production also work.

1.d)

The MR decreases because the downward sloping demand curve tells that the next unit must be sold by a price that is lower than the price of the previous unit. Moreover, this lower price will apply to all units being sold before. Therefore, the MR decreases "faster" than the demand curve (has a steeper slope). In other words, the MR decreases fast because a new unit sold lowers the price for that unit and for all units being sold before.

1.e)

Students must show the profit-maximizing quantity and price in the graph and explain the rationale behind the $MR = MC$ rule: the firm keeps producing as long as the next unit brings in more revenue than costs (as long as $MR > MC$). When $MR = MC$ the firm stops producing and selling, because the next unit will add more costs than revenue. This stopping rule gives the optimal quantity. The price will be determined by the demand curve given this quantity.

1.f)

The profit margin is the difference between the price received by the firm and the marginal cost at the optimal level of output (Q^*). The markup is the profit margin as proportion of the price. The expressions are:

$$profit\ margin = P - MC(Q^*), \qquad markup = \frac{P - MC(Q^*)}{P}$$

Question 2: *Profit and elasticities*

2.a)

Free answer. Students must pick one of the four possible scenarios:

1. Elastic → more elastic
2. Elastic → inelastic
3. Inelastic → more inelastic
4. inelastic → elastic

2.b)

Free answer, but students must come up with estimates that match their answer in "a". That means, numerical estimates ε_{D1} and ε_{D2} must be such that:

1. $\varepsilon_{D2} > \varepsilon_{D1} > 1$
2. $\varepsilon_{D2} < 1 < \varepsilon_{D1}$
3. $\varepsilon_{D2} < \varepsilon_{D1} < 1$
4. $\varepsilon_{D1} < 1$ and $\varepsilon_{D2} > 1$

PS. The way we defined price elasticity of demand in this course, all estimates should be positive numbers.

2.c)

Recall that $\varepsilon_D = -\%\Delta Q/\%\Delta$. Thus, if $\%\Delta P = 10\%$, we will have

$$\begin{cases} \%\Delta Q = -\varepsilon_{D1} \times 10\% = -\varepsilon_{D1}/10, & \text{before the crisis} \\ \%\Delta Q = -\varepsilon_{D2} \times 10\% = -\varepsilon_{D2}/10, & \text{after the crisis} \end{cases}$$

Sales would drop by $\varepsilon_{D1}/10$ before the crisis, and by $\varepsilon_{D2}/10$ now following a 10% price increase.

2.d)

From the law of demand, we know that price and quantity always move in opposite directions: when the price rises, quantity falls; when the price falls, quantity rises. Therefore, a ratio of these two opposite moves will always produce a negative result. Because we are interested in the magnitude of the response in quantity given a change in the price and not the direction of that response (which we already know), we look only at the magnitude of the estimate for the elasticity, not its sign.

We compare the elasticity to one because it is a useful way to compare the numerator (percent change in quantity) against the denominator (percent change in price):

$$\begin{cases} \varepsilon_D = 1 \Longrightarrow \%\Delta Q = \%\Delta P \\ \varepsilon_D > 1 \Longrightarrow \%\Delta Q > \%\Delta P \\ \varepsilon_D < 1 \Longrightarrow \%\Delta Q < \%\Delta P \end{cases}$$

2.e)

Free answer, but the slope of the demand curve—and, consequently, the slope of the MR curve—must reflect the student's choice in "a". That means, for a given slope of the demand curve in the graph on the left, the slope of demand in the graph on the right must be:

1. flatter
2. steeper
3. steeper
4. flatter

The slope of the MR must accompany these changes, being always steeper than the demand curve.

2.f)

The graphical representation must have changed and the change must have been reflected in the slope, as state above. The reason is that, all things equal, a steeper demand represents a more inelastic demand, whereas a flatter demand represents a more elastic demand.

2.g)

Free answer. The answer should reflect the student's choice in "a", but there can still be variation in what happens to Q and P in the end.

2.h)

For scenarios 2 and 3, the demand becomes relatively more inelastic ($\varepsilon_{D2} < \varepsilon_{D1}$). Thus, the profit margin and the markup both increase. For scenarios 1 and 4, the opposite happens.

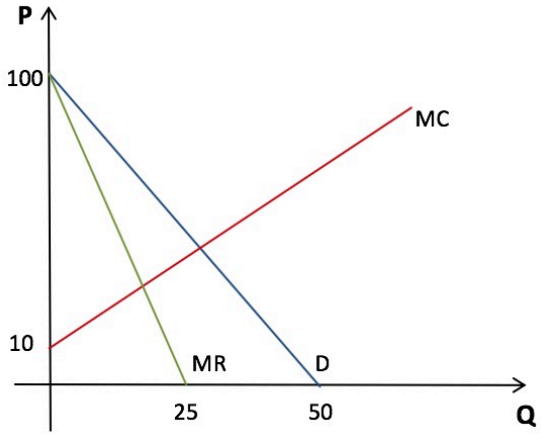
This result can be verified graphically: the vertical distance between the price and the marginal cost (the profit margin) increases at the optimal quantity when demand becomes steeper. It can also be verified mathematically, using the relationship between the markup of the firm and the price elasticity of demand: $\frac{P-MC(Q^*)}{P} = \frac{1}{\varepsilon_D}$. When $\varepsilon_{D2} < \varepsilon_{D1}$, we have $\frac{1}{\varepsilon_{D2}} > \frac{1}{\varepsilon_{D1}}$. Thus, the markup is higher after the change:

$$\frac{P_2 - MC(Q_2^*)}{P_2} > \frac{P_1 - MC(Q_1^*)}{P_1}$$

Question 3: *Gains from trade*

a)

The graph should look like this:



b)

First use $MR = MC$ to find the profit-maximizing quantity Q^*:

$$MR = MC \Longrightarrow 100 - 4Q = 10 + Q \Longrightarrow Q^* = 18$$

Then use this quantity and the demand curve to find the profit-maximizing price P^*:

$$P(18) = 100 - 2 \times 18 \Longrightarrow P^* = 64$$

c)

Consumer surplus:

$$CS = (100 - 64) \times 18 \times \frac{1}{2} = \$324$$

Producer surplus (using $MC(Q^*) = 10 + 18 = 28$):

$$PS = \left[(28 - 10) \times 18 \times \frac{1}{2}\right] + [(64 - 28) \times 18] = \$810$$

Total surplus:

$$TS = PS + CS = \$1{,}134$$

d) *(3 points)*

This situation is not efficient because there are gains from trade that are not being realized. This unrealized surplus is called a "deadweight loss" (DWL) because it is a gain that is being accrued neither by consumers nor by producers.

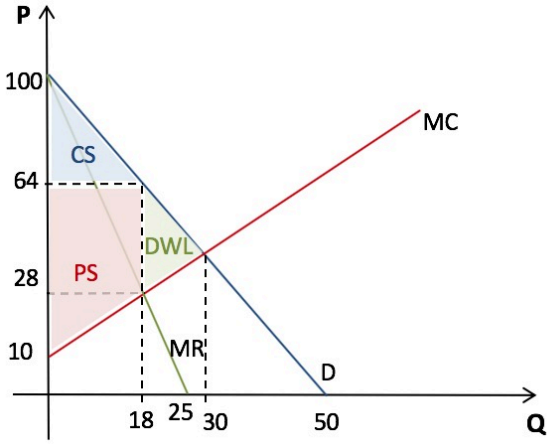
To calculate the DWL, we must first find the efficient quantity (demand equals to MC):

$$P = MC \Longrightarrow 100 - 2Q = 10 + Q \Longrightarrow Q^e = 30$$

Then

$$DWL = (64 - 28) \times (30 - 18) \times \frac{1}{2} = \$216$$

The graph should like this (the CS and the PS, although not required, are also shown in the graph):



e)

The answers for "b" change: the quantity will be higher and the price lower. When sellers are price takers, marginal revenue is equal to the price:

$$MR = P(Q) = 100 - 2Q$$

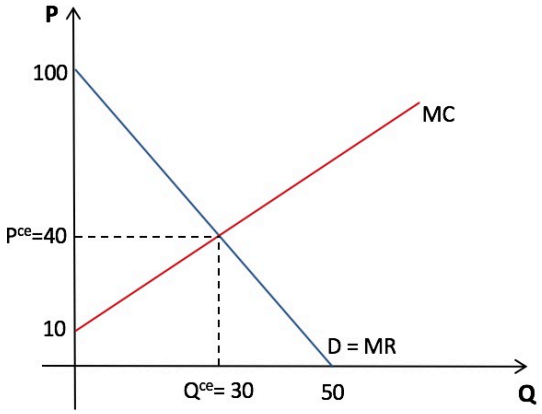
Therefore, using $MR = MC$ to find the profit-maximizing quantity we get:

$$MR = MC \Longrightarrow 100 - 2Q = 10 + Q \Longrightarrow Q^{ce} = 30$$

And using this quantity and the demand (or the supply curve) we find the price of competitive equilibrium:

$$P(30) = 100 - 2 \times 30 \Longrightarrow P^{ce} = 40$$

The graph should look like this:



f)

The answers for "c" change: the consumer surplus increases and the producer surplus decreases. Moreover, total surplus is higher and the difference is equal to the DWL that is now being avoided.

New consumer surplus:

$$CS^{ce} = (100 - 40) \times 30 \times \frac{1}{2} = \$900$$

New producer surplus:

$$PS^{ce} = (40 - 10) \times 30 \times \frac{1}{2} = \$450$$

New total surplus:

$$TS^{ce} = PS' + CS' = \$1{,}350$$

Difference between the new and the old total surplus:

$$TS^{ce} - TS = \$1{,}350 - \$1{,}134 = \$216 = DWL$$

g)

Yes, all gains from trade are being realized (they have been exhausted). It is not possible to improve one side of the market without harming the other side (the situation is Pareto efficient). In other words, the surplus is being maximized in competitive equilibrium.

Question 4: *The effect of taxes (27 points)*

a)

The answer must consider any good, as long as it is a consumption good.

b)

The student must state one goal (if both, one must be the main goal).

c)

Students must state their choice and can present different justifications for it. However, they cannot justify their choice based on tax incidence alone because does not matter which side pays the tax, the incidence is determined by the relative elasticities. Possible answers can address the feasibility of the tax implementation, concerns with the political impacts, and the public's or firms' reaction to the tax.

d)

Free answer. Students must give a numerical estimate that is consistent with their answer to the "price-elastic or price-inelastic" question:

$$\begin{cases} \varepsilon_D = x > 1, & \text{if price-elastic} \\ \varepsilon_D = x < 1, & \text{if price-inelastic} \end{cases}$$

where x is any positive number.

e)

If the choice made in "d" was for price-elastic consumers, then the tax will be more successful to discourage consumption than it will be in terms of raising revenue. On the other hand, if the choice was for price-inelastic consumers, then the tax will be more successful in raising revenue than it will be in discouraging consumption. Students must sketch a graph to support this argument.

f)

As argued in "2.f", all things equal, a steeper demand represents a more inelastic demand, whereas a flatter demand represents a more elastic demand. One could look at the slope of each demand curve given above and pick a relatively flatter one if they made a choice for price-elastic consumers, and a relatively steeper one to represent price-inelastic consumers. Thus, students could pick

$$\begin{cases} \text{demand } A \text{ or } B, & \text{if price-elastic} \\ \text{demand } D \text{ or } E, & \text{if price-inelastic} \end{cases}$$

A more precise answer will actually calculate a point estimate for the price elasticity of demand using the price and quantity of competitive equilibrium, and the information from the demand curve (the inverse of the slope). The result for this estimate must match the choice made in "d". Then, students would pick

$$\begin{cases} \text{demand } A \text{ or } B \text{ or } C, & \text{if price-elastic} \\ \text{demand } D \text{ or } E \quad , & \text{if price-inelastic} \end{cases}$$

The calculations are summarized in the table below:

demand curve	intercept	slope (dP/dQ)	price (P*)	quant. (Q*)	inv. slope dQ/dP	price elast. demand	price elast. supply
A	100	-0.25	82	72	-4	4.56	1.14
B	100	-0.5	70	60	-2	2.33	1.17
C	100	-1	55	45	-1	1.22	1.22
D	100	-2	40	30	-0.5	0.67	1.33
E	100	-4	28	18	-0.25	0.39	1.56

g)

The calculations are summarized in the table below:

	(1)		(2)	(3)	(4)	(5)	(6)
demand curve	price & quant. before		price elast. before	price increase	quantity decrease	tax revenue	deadweight loss
A	$82	72	4.56	$2.40	-9.6	$748.80	$57.60
B	$70	60	2.33	$4.00	-8.0	$624.00	$48.00
C	$55	45	1.22	$6.00	-6.0	$468.00	$36.00
D	$40	30	0.67	$8.00	-4.0	$312.00	$24.00
E	$28	18	0.39	$9.60	-2.4	$187.20	$14.40

h)

The calculations are summarized in the table below:

demand curve	producers		consumers	
	$	%	$	%
A	$9.60	80%	$2.40	20%
B	$8.00	67%	$4.00	33%
C	$6.00	50%	$6.00	50%
D	$4.00	33%	$8.00	67%
E	$2.40	20%	$9.60	80%

i)

The demand curves A, B, and C represent price-elastic consumers. Therefore, they are the “right” ones if the stated goal of the tax was to discourage consumption (and the “wrong” ones if the goal was to raise revenue). Conversely, demand curves D and E represent price-inelastic consumers and are the “right” ones for raising revenue (and the “wrong” ones for discouraging consumption).

Looking only at the numbers produced in “g”, it is not clear right away that one demand curve is better than the other because in all cases consumption will drop and some revenue will be generated. Moreover, if someone computes the numbers for all cases (as we did here), one may arrive at conclusions that run against what we stated in the previous paragraph. For example, curves D and E actually generate the smallest revenues! However, one must consider that we changed slopes but kept intercepts constant for all demand curves (to facilitate calculations). To really show, numerically, the effect of a steeper (or flatter) demand curve on the goals of the tax, we would have to change the intercepts too, keeping the quantity and price constant (like we did in the lecture exercise 8.5.g).