

Homework #1 Due in class Fri 14 Sept

This homework consists of several simple calculations using a linear demand curve and constant marginal costs. It's the framework we'll use all term.

Base case:

fixed costs: $FC = 0$

marginal costs: $MC = c = 2$

demand: $p = D = a - bQ$ where $a = 10, b = 1$

marginal revenue: $p = MR = a - 2bQ$

ϵ (in price): $\Delta Q/Q / \Delta p/p = \epsilon$ noting that $\Delta p = -b\Delta Q$ and $p = a - bQ$

gross margin: $(p - c)/p$

1. Illustrate and/or calculate:

- a. (p, Q) ?
- b. profit?
- c. price elasticity of demand?
- d. gross (profit) margin?

With $p = 10 - Q$, set $MC = 2 = 10 - 2Q = MR$ to get $Q = 4$ and thus $p = 6$. Total revenue $pQ = 6 \times 4 = 24$, but you have to subtract the MC of 2 so $\pi = (p - c) \cdot Q = 4 \cdot 4 = 16$.

Price elasticity $\epsilon = (a - bQ)/-bQ = p / -2 = 6/4 = -3/2$

Price-cost margin $(p - c)/p = 4/6 = 2/3 = 1/\epsilon$ as per theory

2. Let demand **double** for any given price. What is the new D curve? MR curve? Illustrate and/or calculate (a) - (d) as above.

The natural way to do this is to assume 2x the quantity at any given price [rather than 2x the price at any given quantity]. So the demand curve becomes flatter by $1/2$. [In the latter case it becomes steeper by 2.]

So $p = 10 - Q/2$ and $MC = 2 = 10 - Q \Rightarrow (p, Q) = (6, 8)$. $TR = 48$ but $(p - c) \cdot Q = 32 = \pi$. Which is as it ought to be, with everything doubling.

$\epsilon = p / -1/2 Q = -6/4 = -3/2$ as before. The gross margin is then $2/3$ as before. This is an artifact of using a linear demand curve with the same vertical intercept.

3. What happens in (1) and in (2) if MC increases so that $c = 4$?

Obviously with higher costs we would expect quantity and profits to fall. Crunch the numbers and for our original demand curve you get $(p, Q) = (7, 3)$ and $\pi = 15$. $\epsilon = -7/3$ and the margin is $(7 - 4)/7 = 3/7$.

If D doubles, p and ϵ and the margin are all the same but Q and profits double.

NOTE: We always have elastic demand: $|\epsilon| > 1$.

4. What happens in (1) and in (2) if $FC = 10$?

Profit maximization is based on $MC = MR$ so (p, Q) and related variables are unchanged. However, in all cases total profit falls by 10 units.

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Assumptions: Saudi Arabia is 12% of global supply
 OPEC is 36% of global supply
 $\epsilon = 0.25$ [convention leaves off the minus sign, while regression tables include]

5. What happens to global price if Saudi Arabia cuts supply by 10%? What happens to total revenues of Saudi Arabia?

$Q_{\text{Saudi}} \downarrow 10\% \Rightarrow Q_{\text{Global}} \downarrow 1.2\%$ and with $\epsilon = 1/4$ we have $p \uparrow 4.8\%$. Round to 5%.

Now TR changes by $(1 + \Delta p)(1 + \Delta Q) = \Delta p + \Delta Q = 5\% - 10\% = -5\%$. By themselves the Saudis don't have much market power want to pump as much as they can, not cut output to drive up prices.

6. What happens if Saudi Arabia can convince the rest of OPEC to join their supply cut?

$Q_{\text{Saudi}} \downarrow 36\% \Rightarrow Q_{\text{Global}} \downarrow 3.6\%$ and with $\epsilon = 1/4$ we have $p \uparrow 13.4\%$. Round to 13% and we have $TR = +3\%$. So if all of OPEC goes along, an output cut makes sense.

7. At one time Saudi Arabia had marginal production costs near zero – they just had to dig a shallow hole in the ground. No longer. Does this analysis carry through if costs are \$30 per barrel?

Assume the purchaser pays all transport costs. For actual prices and recent stories in the business and industry press go to: <http://www.wtrg.com/>. Use a round number for price that is close to reality.

If $p = \$70$ then the net margin is \$40 and so the price increase is 5% of \$70 or \$3.50. So the net margin for Saudi Arabia increases to \$43.50 which is closer to but still less than 10%. However, if costs were a higher – \$40 would give a gross margin of \$30 – the price increase would be above 10% and it would make sense for SA to unilaterally cut output. So to follow up on this requires more empirical work: how much does it cost to pump oil from the sands of the Arabian peninsula? How certain are SA's estimate of demand?

8. Think and file away: What are the incentives for smaller OPEC members such as Gabon? Are they the same as for Saudi Arabia or Kuwait? (We're not at the point on the syllabus where we'll discuss this.)

If a small member such as Gabon doesn't play along, it's a rounding error to total OPEC output. They get the benefit of higher prices without the cost of lower output. In practice, cheating within OPEC is rampant. At one time this extended to repainting the depth markings on the hull of oil tankers so that "spotters" with

Fall 2018

Syllabus

Economics 243

MWF 1:30-2:30

EarlyFielding 200

binoculars couldn't be sure how much oil was being shipped. Official statistics ... well, why should a kingdom bother with such?