

1 Question 1

The assumption that I'm making through out the question is that the objective of all countries is short term profit maximisation. One could convincingly argue that OPEC's objectives are primarily long term profit maximisation which translates into rather different objectives in the short term such as the stability of the world oil market. However for the purposes of illustrating these models I will assume short term profit maximisation is the objective

1.1 Textbook Cartel

Under the textbook cartel model countries maximise the sum of the profits of all member countries. One could just as easily think of the countries acting as a monopoly. If this is the case then the price in the market is the monopoly price and production occurs in the countries with the lowest production costs such that the marginal cost of extracting an extra barrel of oil from any country producing ($q > 0$) below its total capacity is equal. The effect of production shock in Venezuela would be to shift the monopolies collective supply curve inwards $S^0 \rightarrow S^1$, see below. This would result in an increase in prices ($P^0 \rightarrow P^1$) and a fall in quantity ($Q^0 \rightarrow Q^1$). The fall in quantity from Venezuela will be partially offset by other member countries of OPEC which increase production.

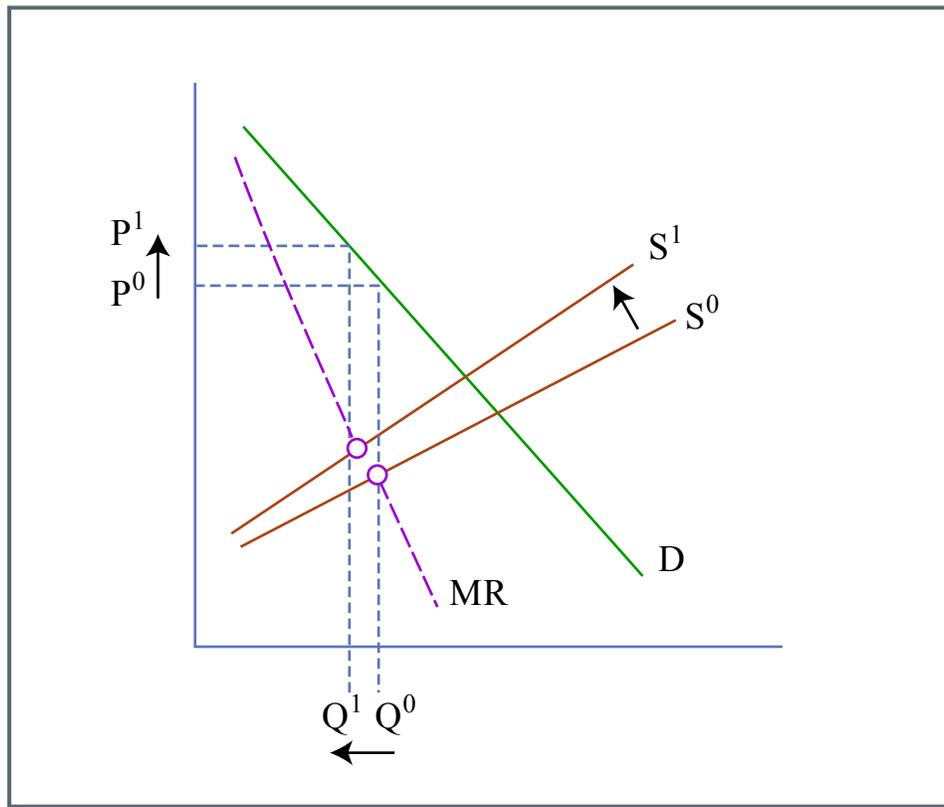


Figure by MIT OCW.

1.2 Dominant firm with competitive fringe

I will analyse the case shown below where the dominant firm has much lower production costs than the competitive fringe. I will also assume that Venezuela is part of the competitive fringe rather than the dominant firm. This situation is shown in the diagram. Note that in the diagram the dominant firm makes its pricing decision off the residual demand curve. The residual demand curve is the demand curve minus whatever production the fringe will provide at that price. The dominant firm then acts as a monopolist would if faced with the residual demand curve. A shock to oil production in Venezuela would shift the supply curve of the fringe to the left and subsequently push the residual demand curve to the right. When the dominant firm has much lower costs than the fringe we see that unlike earlier the dominant firm reduces production compared to earlier where all other countries increased production in response to the shock. Otherwise market output falls prices rise and other fringe suppliers increase production. The marginal costs of production will be the same across all fringe suppliers (equal to the market price) and much lower for the dominant supplier.

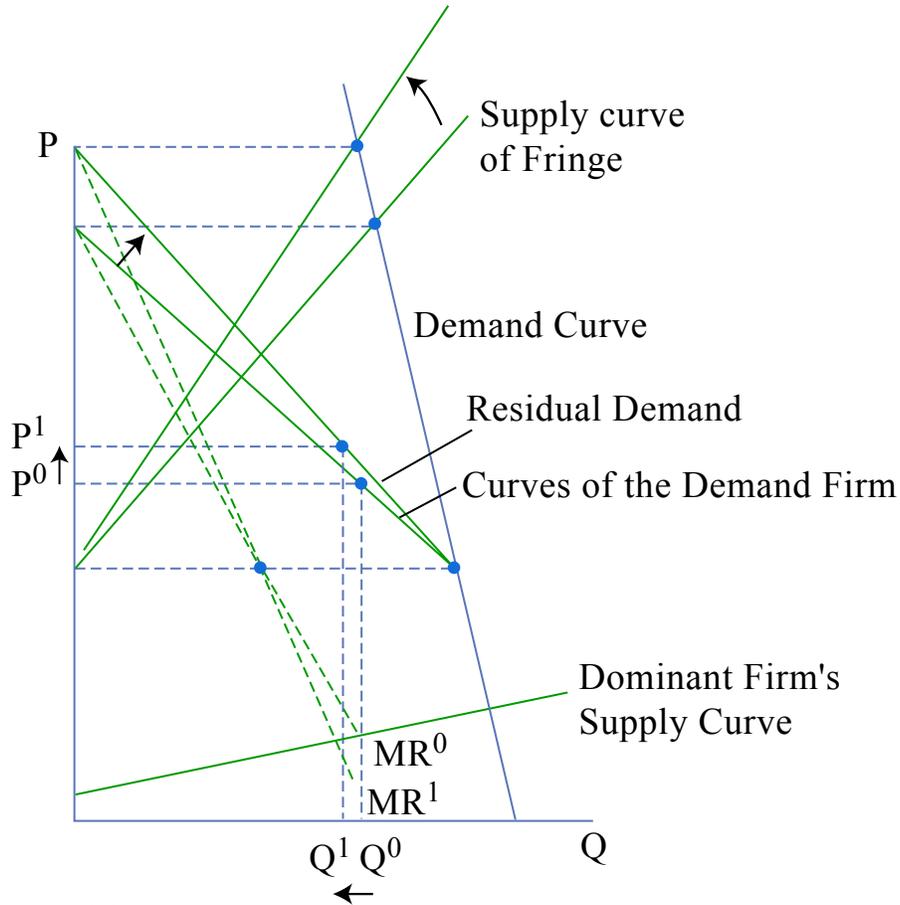


Figure by MIT OCW.

1.3 Cournot Competition

Cournot competition is where producers compete through choosing quantities. In its simplest form imagine a producer i with a cost function $C_i(q_i)$. Define profits π_i as

$$\pi_i(q_i) = P(Q)q_i - C_i(q_i)$$

where $P(Q)$ is the demand curve and Q is the total market output $Q = \sum_i q_i$.

Each producer maximises their individual profits taking the output decisions of other producers as given. Their objective is therefore

$$\max_{q_i} \pi_i$$

taking first order conditions we get

$$P'(Q)q_i + P(Q) - \frac{\partial C_i}{\partial q_i}(q_i) = 0$$

rearranging

$$P(Q) = \frac{\partial C_i}{\partial q_i}(q_i) - P'(Q)q_i$$

noting that the right hand side is increasing in q_i it should be clear that producers with the lower marginal costs of production will produce a greater proportion of total output Q . When there is a supply shock in Venezuela

$q_{Venezuela} = 0 \Rightarrow Q \downarrow$ if no other countries change their production levels then for all these other countries

$$P(Q) > \frac{\partial C_i}{\partial q_i}(q_i) - P'(Q)q_i$$

is now true because Q is smaller (so $P(Q)$ has increased) and q_i is unchanged. All other countries will therefore have an incentive to increase their output at the next opportunity. This increase however will not completely offset the reduction from Venezuela. In conclusion $Q \downarrow$, $P \uparrow$ and $q_i \uparrow$. Also the marginal cost of production will differ across countries, it will be lower than the price and negatively correlated with the countries share of total output.

1.4 Perfect competition

The effect of a shock in Venezuela in a perfectly competitive market is the familiar shifting of a supply curve. That is the market quantity goes down and the price increases. Other countries will increase production to partial offset the fall in production however they will not completely do so. Price will be equal to marginal costs of production which will be equal across countries with unused capacity.

1.5 Differentiating these models

Differentiating between these models on the basis of just these comparative statics relies heavily on knowing the marginal costs of production which are for the most part unobservable and otherwise difficult to estimate. If we could only observe the price and quantity movements then we would have some difficulty distinguishing these models. With the exception of the dominant supplier in the second model whose output falls, all other movements are similar across models.

2 Question 2

- a) This is just a simple shift of the demand curve. Prices are all identical because costs are simply passed through so the shift in the demand curve increases production and prices.
- b) Now there is a price ceiling on domestic field prices. The effect of this on the aggregate supply curve is shown below. Any production above the level at the price ceiling must be met by imported natural gas. The effect of this on the supply curve is to make it steeper in the region above the price ceiling compared to the supply curve without a price ceiling. Pipelines are regulated to charge the average price of imported prices and domestic prices which I assume is a quantity weighted average so that pipelines just break even. The market equilibrium is for import prices and quantities to increase, field prices and quantities to remain the same, and consumer

quantities and prices to increase. The price faced by consumers will be the weighted average of the import and domestic gas prices.

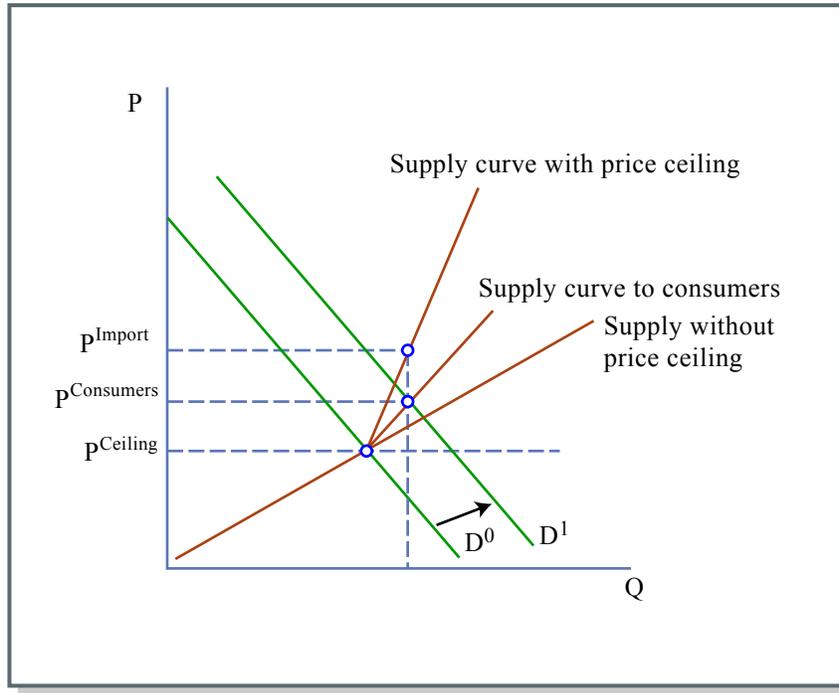


Figure by MIT OCW.

- c) If the pipeline was operating at full capacity prior to the shock then we have the situation shown below. Supply cannot respond to the demand increase so in order for the market to clear the price faced by consumers must increase to P^1 . In this case there is a congestion rent due to the difference between P^1 and P^0 . This can be captured by any of the distributors, producers or the pipeline itself depending on the relative bargaining powers of each.

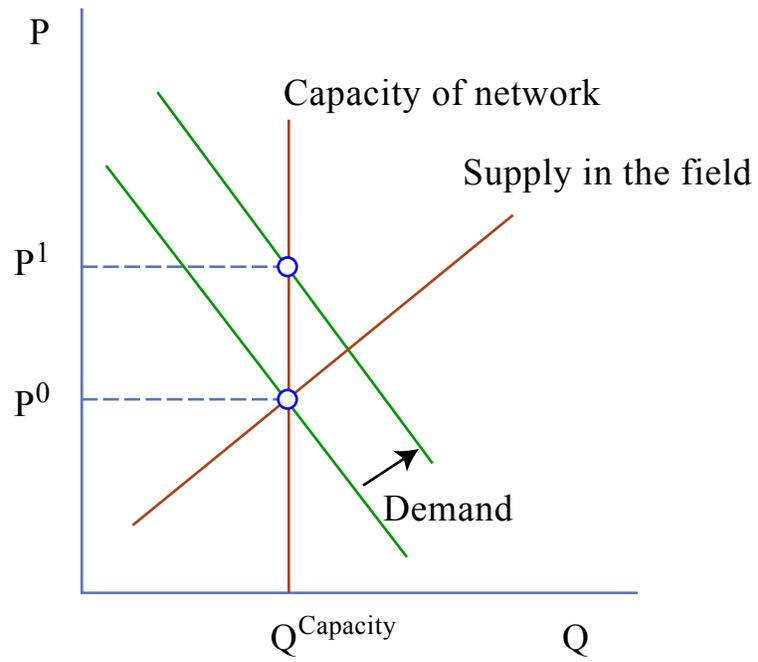


Figure by MIT OCW.