Chapter 10 & 11: Bertrand competition

4.1 Oligopolistic price competition

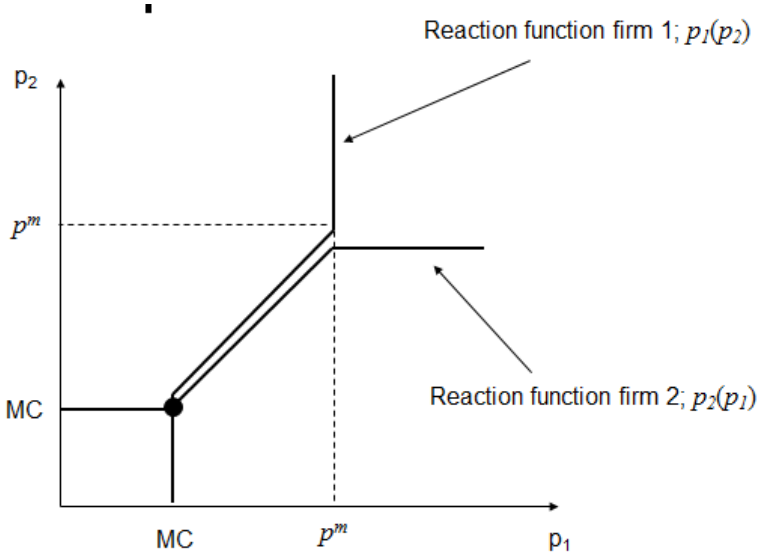
Cournot argued that firms choose an output level and that prices adjust to this. Many years after Cournot, **Bertrand** criticized these assumptions. He argued that in imperfectly competitive markets firms choose prices instead of output levels and that they sell the quantities demanded at those prices. Keeping all other things of the Cournot model the same, there is one other thing that also differs; the residual demand curve.

If both firms in the market charge the same price, consumers will buy random from a firm. In this case people buy from both firms and thus each firm serves halve of the market and they both have positive profits.

But if one firm charges a price that is slightly lower than the price the other firm charges, its profit margin will almost remain the same, while the sales of this firm will almost double. This leads to higher profits.

When each firm sets a price equal to marginal cost, to maximize profits, it assumes that all other firms also set prices equal to marginal costs. But if every firm does this they make zero profits. This is called the **Bertrand Paradox.**

With homogeneous products, the reaction curves (best-response curves) of firm 1 and 2 look like:



If we combine horizontal differentiation with the price-setting duopoly model we get the inverse demand functions:

$p_1 = 100 - (q_1 + \theta q_2)$

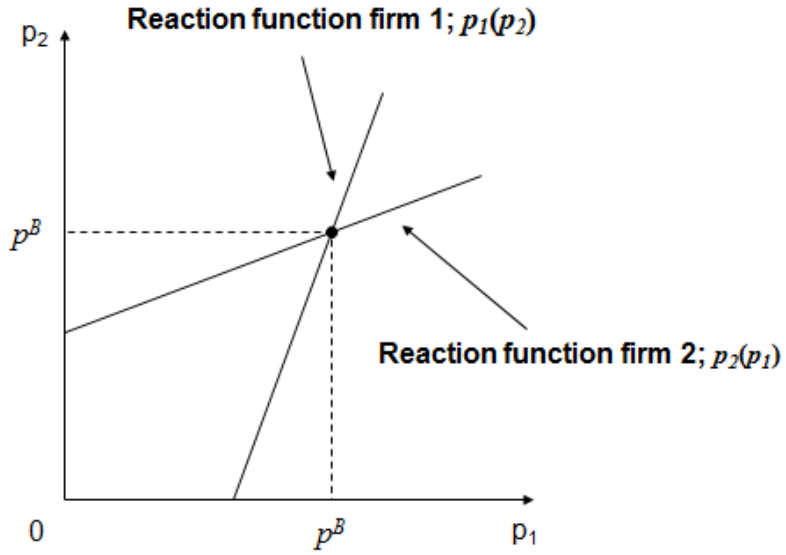
$p_2 = 100 - (q_2 + \theta q_1)$

θ is a number between 0 and 1 that measures the degree of substitutability between the two varieties.

- If θ=0, the quantity of variety 2 has no influence on the price of variety 1, and vice versa.

- If θ=1, the varieties are perfect substitutes. The two demand functions become identical and reduce the homogeneous product demand function.

The reaction curves of differentiated products look like:



The prices are **strategic complements** for the firms; an increase in one price makes profitable an increase in the other price. This is the case with Bertrand competition.

But in case the firm does not state prices but it states output, like in the Cournot model, then output is a **strategic substitute** for the firm; an increase in one making profitable a reduction in the other.

The Bertrand equilibrium is found by solving the reaction equations of the firms. It is found where both reaction curves intersect. The greater the degree of product differentiation, the greater the equilibrium price-cost margin. As long as products are differentiated, equilibrium price-cost margins fall as the number of firms rises.

Bertrand competition is more competitive than Cournot competition. The reaction curves (best-response curves) in Bertrand competition are upward sloping instead of downward sloping, like with Cournot competition.

4.2 Stackelberg model

We are going to take a look at a duopoly model where one firm (1) has an informational advantage over the other firm (2). This model is often called the **model of Stackelberg**. The two firms choose quantities sequentially. The firm that moves first is the leader firm and the firm that moves second is the follower firm.

In this model the follower, firm 2, makes its output decision as he would do in the Cournot model and the leader, firm 1, knows this. Firm 2 produces the output that maximizes its own profits given the output produced by firm 1. Firm 1 knows how firm 2 will act and will therefore take this into account when deciding how much to produce.

Firm 1 will produce another output than it would produce as a Cournot duopolist. The reaction

function of firm 2 in the Stackelberg model is different from the reaction function in the Cournot model.

An example:

1. If the inverse demand curve is:
   $p= 100 – (q_1 – q_2)$

2. and the cost function is:
   $c (q) = 10q \lozenge mc = 10$

3. Then the reaction function of firm 2 (p = mc) is:
   $q_2= 45 – 0.5\ q_1$

The residual demand curve of firm 1 will be: $p = (100 – q_2) – q_1$

If we substitute the reaction curve of firm 2 in this equation, the residual demand curve of firm 1 will be:

$p = (100 – (45 – 0.5q_1)) – q_1 = 55 – 0.5q_1$
To maximize profits, firm 1 will set marginal costs equal to marginal revenue.

$MR= 55 – 2(0.5q_1) = 55 – q_1$

$MR = MC$ gives $55 – q_1 = 10 \quad \lozenge q_1 = 45$

If we know q_1 we can calculate $q_2 \lozenge q_2 = 45 – 0.5 \times 45 = 22.5$

The total output produced under the Stackelberg leadership is 45 + 22.5 = 67.5

And the equilibrium price is 100 – 67.5 = 32.5

The Stackelberg output is higher than in the Cournot equilibrium and the price is lower. The total profits made exceed the profits made in Cournot equilibrium. Both firms earn higher profits when price competition is sequential instead of simultaneous. A crucial point in a sequential game is commitment. A firm has to have a pricing strategy that is credible to its rivals.

Sequential games cannot have subgames but dynamic games can. To understand whether a firm's strategy is credible in such a dynamic game we have to use the concept of **subgame perfection**. This means that if a strategy chosen at the start of the game is optimal, it must be optimal to stick with that strategy at every later point in the game.

In a dynamic game, the strategy of the firm is a set of instructions that tell the firm what action it must take in each situation.