DUOPOLY – A NEW APPROACH

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Abstract: We describe here a model which can explain the way a duopoly functions. The main part of the model concerns the price competition. Price competition and collusion can explain the equilibrium of the firm.

Oligopoly has been studied already and few models have been constructed. We still found useful a new approach because tree reasons:

1) The classic model for oligopoly (and also for perfect competition) is based on the law of diminishing returns. But this law applies only in agriculture.

We give some examples of products and variable factors where the quantity of product and the quantity of variable are proportional. (We assume the quality of product and the quality of the variable factor constant): Flour – bread, milk – cheese, methane gas – terminal energy, tobacco – cigarettes.

We remind that we use in practice two indicators: specific (technologic) consumption, and work norm. Both of them are constants and do not depend on the quantity of production realized.

2) The classic models do not take into account the price competition. But the price competition is the main type of competition under the condition of a homogenous product

3) The classic models do not take into account a finite capacity of production. In the real world the capacity of production is finite.

The model build by us is based on the assumption that firms are identical. This means that the firms produce an identical product, use the same technology and have the same capacity of production. (We also consider that the variable factor of production is the raw material).

There are a few consequences of these assumptions:

If both of the firms charge the same price for the product we can derive an individual demand curve for each of them. At any price the individual demand is half of the total demand.

If both of the firms charge the same price for the raw material, we can derive an individual supply curve for raw material. At any price the individual supply is half of the total supply of raw material.

We also can construct the individual curve for average total cost (ATC). Let us analyze the shape of the average total cost.

The average fix cost (AFC) decreases when the production increases.

\[ CFM = \frac{CF}{Q_p} \]

The average variable cost (AVC) increases when the production increases.
Under the given conditions, the quantity of war material is proportionate with the quantity of product. We can derive:

\[ Q_{mp} = K \cdot Q_p \quad \text{Where} \quad K = \frac{Q_{mp}}{Q_p} \]

is the specific consumption.

The average variable cost will be:

\[ C_{V\text{M}} = \frac{Q_{mp} \cdot P_{mp}}{Q_p} = \frac{Q_{mp} \cdot P_{mp}(Q_{mp})}{Q_p} = \frac{K \cdot Q_p \cdot P_{mp}(K \cdot Q_p)}{Q_p} = K \cdot P_{mp}(K \cdot Q_p) \]

Starting from this relation we can conclude that if production increases the average variable cost increase.

The average total cost being the sum of the average fix cost and the average variable cost have a decreasing part and an increasing part.

The explanation of the price competition.

The initial situation.

Both firms charge the same price for the product \( P_{p_0} \) and for the raw material \( P_{mp_0} \). Under these conditions both firms will produce and sell the same quantity of product \( Q_{p_0} \) and purchase and consume the same quantity of raw material \( Q_{mp_0} = K \cdot Q_{p_0} \). The point \((Q_{p_0}, P_{p_0})\) will be situated on the individual demand curve, and the point \((Q_{p_0}, CTM(Q_{p_0})\) will be situated on the individual average total cost curve. We assume that \( Q_{p_0} < C_p \).

(Graph 1)

The intermediary situation

One of the firms, firm A, will decrease the price for product to \( P_{p_1} \) and will increase the price for raw material to \( P_{mp_1} \). Firm B will maintain the initial prices for product and raw material.

Under these conditions the entire demand for product will orientate to firm A. But the firm A can not satisfy the entire demand. It will satisfy a part of this demand \( Q_{pA} \) which is equal to the production capacity \( C_p \).

The entire supply of raw material will orientate to firm A. But the firm A can not by the entire supply. It will buy just a part \( Q_{mpA} = K \cdot C_p \) of this supply, this part corresponding to the capacity of production. (Graph 2)

Let us see what happens to the profit of firm A:

The profit will increase because firm A will chose prices in the way that the effect on profit of the decrease of the product price and the effect on profit of the increase of the average total cost (due to the increase of the average variable cost – caused by the increase of the raw material price) will be smaller then the effect on profit of the increase of the quantity sold. (The quantity of product increase from \( Q_{p_0} \) to \( Q_{pA} = C_p \)). Note that average total cost can even decrease because of the decrease of the average fix cost.

We suppose that both firms do not know the individual demand curve for product, the individual supply curve for raw material, and the individual average total cost curve. Firm A still can calculate the profit before the decrease of the product price and the increase of the raw material price. Firm A knows:
The price of the product – is charged by itself
The quantity of the product – equal to the capacity of production
The price of the raw material – is charged by itself
The quantity of raw material – knowing capacity of production and specific consumption
The fix cost – is known

Because firm A can not totally satisfy the demand for product, a part of the total demand for product remains for firm B. Also, because firm A can not buy the entire supply of raw material, a part of the total supply of raw material remain for firm B. (Graph 3)

Let us see what happens to the profit of firm B:
The profit of firm B will decrease because, on the one hand the remaining demand for product at the price $P_p_0$ noted $Q_p_B$ is smaller than the quantity $Q_p_0$, on the other hand because the average total cost increases (The average fix cost increase and the average variable cost remain the same) (Graph. 3)

The final situation
The firm B copies the prices of firm A for product and for raw material. The total demand for product will be distributed again equally. The total supply of raw material will be distributed again equally.

Both firms will produce a quantity of product $Q_p_1$ which will be sold at price $P_p_1$, and will purchase and consume a quantity $Q_m p_1$ which will be purchased at price $P_{m p_1}$.

The point $(Q_p_1, P_p_1)$ will be situated on the individual demand curve and the point $(Q_p_1, CTM (Q_p_1))$ will be situated on the individual average total cost curve. (Graph 4)

Let us compare now the profits of firms in the initial situation and final situation
a) If $Q_p_0$ and $Q_p_1$ are smaller than the quantity of product corresponding to the maxim profit, the profit will increase.
   If $Q_p_0$ is smaller than the quantity of product corresponding to the maxim profit and $Q_p_1$ is larger than the quantity of product corresponding to the maxim profit, the profit can increase, decrease or remain the same.
   c) If $Q_p_0$ and $Q_p_1$ are larger than the quantity of product corresponding to the maxim profit, the profit will decrease. (See Graph 4)

The case c) is the most interesting because it gives us an example which have been studied and explained by the Games theory. The game theory did not studied situations where price competition leads to increase profits (Case a)).

Conclusions

Competition depends on capacity of production unused. If firms already produce at full capacity, price competition can not exist.

The equilibrium of the firm depends on the initial production. If the quantity is situated to the left of the quantity corresponding to the maxim profit, price competition will lead to a better situation for both firms.