BERTRAND MODEL

The Oligopoly model in which firms choose prices simultaneously, treating prices of its rivals as fixed, was developed by one French economist, Joseph Bertrand. Let us assume there are two firms in the market producing a homogeneous product. The market demand curve is assumed to be,

$P = 30 - Q$

where Q is the total production of homogeneous product. We also assume that both the firms have a fixed marginal cost of Rs. 3.

$MC_1=MC_2=3$

It is to be noted here that as the good is homogeneous, consumers will purchase the good only from that seller who charges the lowest price. Thus, if the two firms charge the same price, the lowest-price firm will charge the entire market and the higher price firm will not be able to sell any amount. Now if both the firms charge the same price, then the consumers will be indifferent as to which firm they buy from and then each firm will supply half the market.

In Bertrand model, the Nash equilibrium is the competitive outcome i.e. both the firms charge the price equal to the marginal cost: $P_1 = P_2 = 3$. So, both the firms earn zero profit at equilibrium. Total output in the market, $Q = 27$ units where each firm produces 13.5 units.

To check that this outcome is a Nash equilibrium, we have to examine whether the firms have any incentive to change price. If any one firm raises its price, then it would lose all of its sales and therefore be worse off. Again if either of them lowers the price then it would capture the entire market, but would suffer loss on every unit of its production and be worse off again. Therefore, each firm has no incentive to deviate as it is doing the best it can to maximize profit, given what the rival firm is doing.

The reason for not settling the Nash equilibrium at a higher price is that if either firm lowers its price just a little, it can capture the entire market and raise profit. Thus each firm would want to undercut its competitor. Such undercutting would continue until the price dropped to the level equal to marginal cost.

With differentiated Products

Oligopolistic markets often have some degree of product differentiation. In such cases, it is natural for firms to compete by choosing prices rather than quantities. The two firms choose their prices at the same time, each taking its competitor's price as given.

Let us assume there are two firms in the market, each having the fixed cost of Rs.20 but zero variable costs. The two firms face the following demand curves:

Firm 1's demand: $Q_1 = 12 - 2P_1 + P_2$ (1)

Firm 2's demand: $Q_2 = 12 - 2P_2 + P_1$ (2)

where P_1 and P_2 are the prices that firm 1 and 2 charge, respectively and Q_1, Q_2 are the resulting quantities that they sell. It should be noted here that quantity that each

firm can sell decreases with increase in its own price, but increases with increase in the price that it's competitor charges.

We use the Nash equilibrium concept to determine the resulting prices. Let us begin with firm 1, it's profit is given by,

$$\pi_1 = P_1 Q_1 - 20 = 12P_1 - 2P_1^2 + P_1 P_2 - 20$$

At what price firm1's profit will be maximized depends on P_2, which firm 1 assumes to be fixed. Taking P_2 as fixed, firm 1's profit maximizing price is therefore given by,

$$\frac{\Delta \pi_1}{\Delta P_1} = 12 - 4P_1 + P_2 = 0$$

$$\Rightarrow P_1 = 3 + \frac{1}{4} P_2 \qquad (3)$$

Equation (3) is the equation of reaction curve for firm 1; it tells what price firm 1 will set, given the price P_2 that firm 2 has set. Similarly, firm 2's reaction function may be expressed as,

$$P_2 = 3 + \frac{1}{4} P_1 \qquad (4)$$

The reaction curves are drawn in the following diagram. The point of intersection of the two reaction curves gives us the Nash equilibrium point. At that point each firm is doing the best it can given the price of its competitor, neither firm has any incentive to change its price. In this example, at Nash equilibrium each firm will chage Rs. 4 and earn a profit of Rs. 12.

However, in this case also the two firms may collude (to act as monopolist) and maximize joint profit by deciding the same higher price, instead of choosing their prices independently. Then the firms would charge Rs. 6 in this example and

would be better off colluding because each would now earn a profit of Rs. 16. The collusive equilibrium is shown in the diagram.