

**Cooleconomics.com****Monopolistic Competition and Oligopoly**

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Introduction:

So far in this class we have examined two types of market structures—perfect competition and monopoly. Now we shall examine two other market structures—monopolistic competition and oligopoly.

**Monopolistic Competition**Attributes:

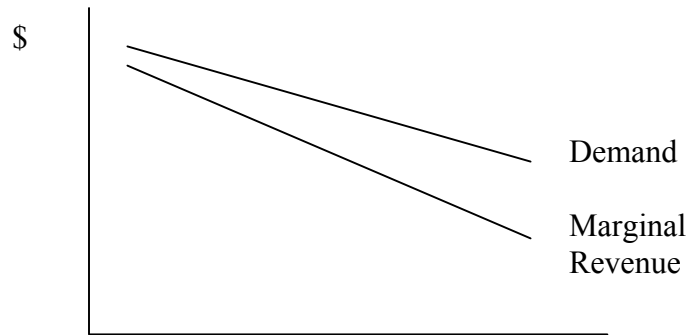
In a monopolistically competitive market, there are many, many small sellers, each of whom sells a *slightly different* product.

Examples: The Chinese food dining market, the plumbers market, the dry cleaners market.

Revenues of a monopolistically competitive firm:

If a monopolistically competitive firm increases the selling price of its product, then it will lose a lot of business, but not all of its business. (Compare this outcome to that of a perfectly competitive firm; if a perfectly competitive firm raises its price it WILL lose all of its business, since its competitors sell an identical product. This fate does not fall a monopolistically competitive firm, since none of its competitors sell exactly the same product that it does.)

We can graph the revenues of a monopolistically competitive firm with a not-too-steep demand curve, and with a not-too-steep marginal revenue curve below it. (Compare this graph to a perfectly competitive firm, which has a horizontal demand curve, illustrating the futility of price hikes for the perfectly competitive firm—it loses all of its business. Since a monopolistically competitive firm does not lose all of its business, its demand curve is not quite horizontal—but it is not as steep as a pure monopoly’s demand curve.)



### Profit-Maximizing Strategy:

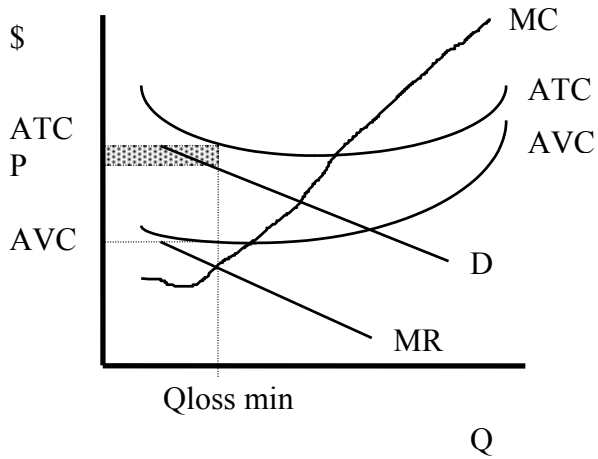
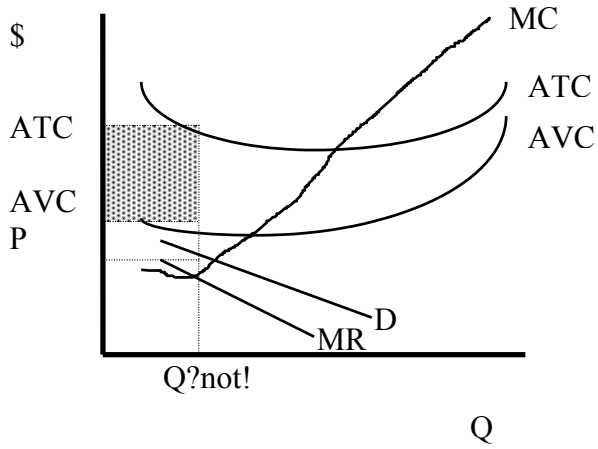
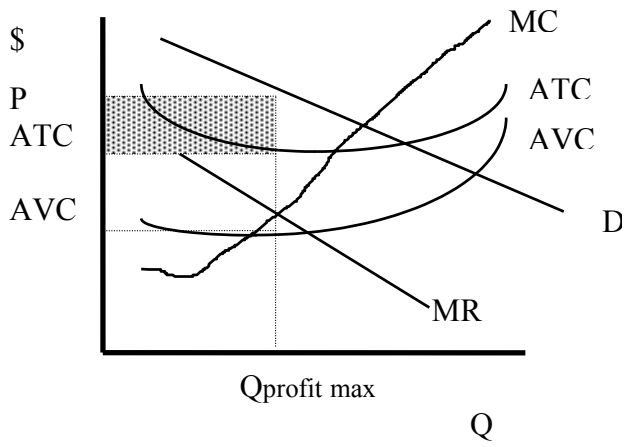
As with most types of firms, a monopolistically competitive firm should produce the quantity of output where marginal revenue = marginal cost. (Unless price is below average variable cost, in which case the firm should shut down.)

### Short run performance

As you know, pursuing a profit-maximizing strategy is no guarantee of profits. As with any type of firm, a monopolistically competitive firm, even though it follows a profit-maximizing strategy, may face three possible situations in the short run (depending on how much demand there is for its product relative to the costs of producing the product):

- 1) The firm may operate at a profit, if demand for the product is high relative to costs.
- 2) The firm may shut down if it can't generate enough revenue to even cover the variable costs.
- 3) The firm may operate at a loss, if it can generate enough revenue to cover its variable costs but not enough to cover all of its costs

These three situations are depicted in order on the next page of notes.



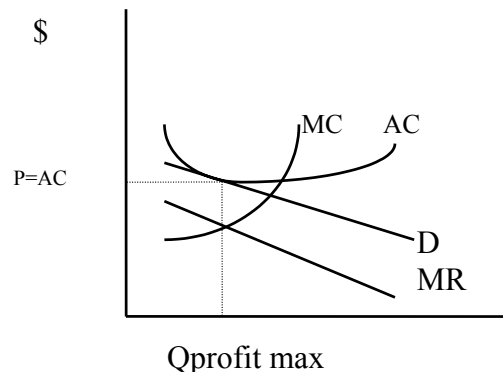
Importance of advertising:

Some economists stress the importance of advertising in the monopolistically competitive market structure, in order for a firm to emphasize (and perhaps exaggerate?) the differences in its product that make it worth buying. Since the differences are slim among sellers, the advertising may be vital to get the buyer to be somewhat loyal to the firm (and keep its demand curve high).

(Witness all of those coupon booklets and such that you receive in the mail, advertising the goods and services of small firms. Most of these firms operate in monopolistically competitive markets.)

Long run: zero economic profits

A firm in a monopolistically competitive market structure is doomed to zero economic profits in the long run. Why? Well, if it were lucky enough to have short run profits, then it will face stiff competition as new firms enter the market, driving selling prices down until profits are eliminated. Bummer. Here's a graph of the situation:

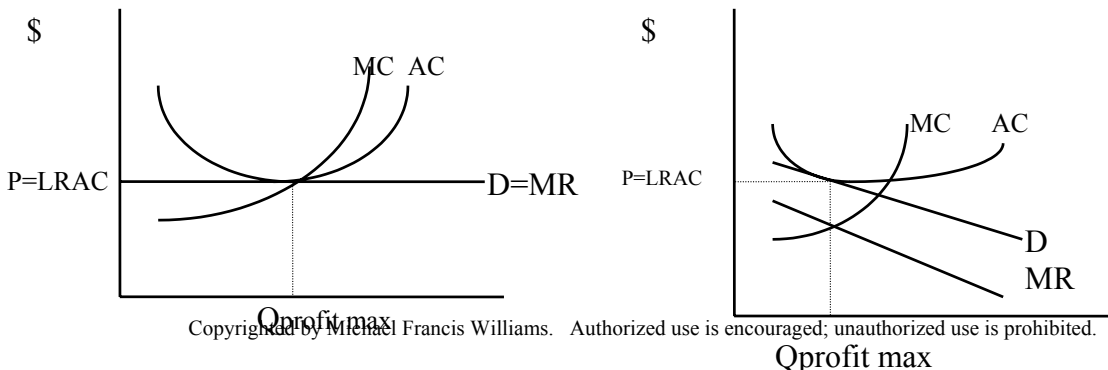


Excess capacity of monopolistic competition

Look at the above graph. Look at it, dang it! Notice that production does not take place at the lowest feasible average cost. (The lowest feasible average cost occurs at the absolute lowest point of the AC curve—the bottom of the “U”.) Instead, the quantity is smaller than that lowest average cost output. This is why it is sometimes said that there is an excess capacity to monopolistic competition—each firm produces output smaller than the lowest average cost level.

Socialist Critique of Monopolistic Competition

Compare the long run equilibrium of a perfectly competitive firm with that of a monopolistically competitive firm: (The perfectly competitive firm is on the left)



Perhaps you can see that the perfectly competitive firm—with each seller producing an identical product—produces at lower average cost than the monopolistically competitive firm. This had led some Socialist economists to complain that there is *needless product differentiation* in monopolistically competitive industries, aimed more at deceiving and confusing buyers rather than serving them, which raises prices for consumers and provides them with little benefit. Restrictive government regulations, they argue, which force sellers to adhere to strict product standards, would benefit consumers.

(This assumes that buyers are idiots and can be easily duped by advertising. Yet somehow these socialist thinkers aren't duped; apparently they think that they are smarter than the average citizen. I don't like these elitist views.)

## Oligopoly

### Attributes:

In an oligopoly, there are a few large sellers dominating the market, each of whom may produce either an identical or a differentiated product.

Examples: crude oil, automobiles, airlines, steel, etc.

(Most production in the U.S. takes place under conditions of oligopoly.)

### Strategic decision making

Since a firm in an oligopoly has only a few competitors, it must try to predict the expected reactions of its rivals to any action that it takes. This is known as strategic behavior, or *strategic decision making*.

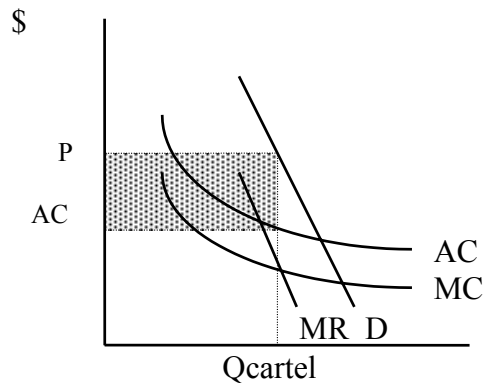
### Some older models of oligopoly

Below we shall present some older models of oligopoly. (These have largely been supplanted by the use of game theory to analyze oligopoly. We shall discuss game theory later in these notes, and in greater detail in a subsequent set of notes.)

#### Oligopoly Model #1: Cartel

If legal, it is generally best to cooperate with one's fellow producers, jointly deciding with them how much production there will be in the market and what prices will be charged.

A cartel in which all firms in the market are members, and in which all of the members fully cooperate, acts as a monopoly, since the firms are in effect acting as one large firm. This assures profitability, as in the following graph (which looks sneakily like a monopoly graph):



The graph above is of the entire market, and it shows the combined output of all of the members of the cartel. The shaded area is the joint profits of all of the producers (which they have to figure out how to split).

Problems with cartels:

*Incentive to cheat:* Suppose only one of the members of the cartel violated its output agreement; instead, it produces a bit more than it's supposed to, selling it a bit below the cartel's price. Well, this one firm would make a little extra money. BUT WAIT! If this is true, then there's an incentive for all of the firms to cheat, and produce a little extra. This floods the market with product, driving prices down, destroying the effectiveness of a cartel.

*New firms:* In an effective cartel, each of the members must be satisfied with its market share, and agree to limit its production. But new or aggressive firms may want to increase market share; they will compete with the other firms, driving prices down, unless they can be persuaded to join the cartel. Often they are not persuaded, and the cartel's power is eroded.

*Illegal:* In many countries, including the U.S., most cartels are illegal.

### Oligopoly Model #2: Price Leadership:

Under this theory of oligopoly, the largest firm sets prices, and the other firms *always* follow the lead of the largest firm. The U.S. auto market of the 50s and 60s is sometimes held as an example of price leadership; GM would announce price hikes in the Fall for its cars, and Ford and Chrysler would soon after announce virtually identical price hikes.

Tacit collusion:

Perhaps you can see that price leadership is almost as good as a cartel. If the dominant firm knows that the other firms will definitely follow its price lead, then they can feel free to set a high, profitable price. The other firms will be happy to follow the lead and also set a high profitable price. This is why price leadership is sometimes called *tacit* collusion.

Problems with price leadership:

*Doesn't work with too many firms:* If there are too many firms, then at least one is surely not going to be satisfied with its market share, and will hence compete with the dominant firm on price. (Japanese car companies certainly did this in the U.S. in the 70s.)

*May be illegal:* Depending on who is enforcing antitrust laws, a price leadership strategy may be judged to be illegal price setting.

### Oligopoly Model #3: Cost Plus Pricing

This is a really dumb pricing strategy, in which the firm always sets its product prices equal to average cost + some percentage markup.

Problems with cost plus pricing:

Like the “little man” in Alan Jackson’s song, a firm that uses this obsolete strategy will surely fail, since this strategy fails to take into account the strategies of competitors. Sears lost its place as #1 retailer by trying to adhere to this strategy, while Wal-Mart and K-Mart undercut its prices.

### Oligopoly Model #4: Kinked Demand Curve: (a.k.a. Rigid Prices Model)

Assumes the following:

--If 1 firm in an oligopoly *raises* its prices, then *none* of the other firms in the oligopoly will raise theirs.

--If 1 firm in an oligopoly *lowers* its prices, then *all* of the other firms in the oligopoly will lower theirs.

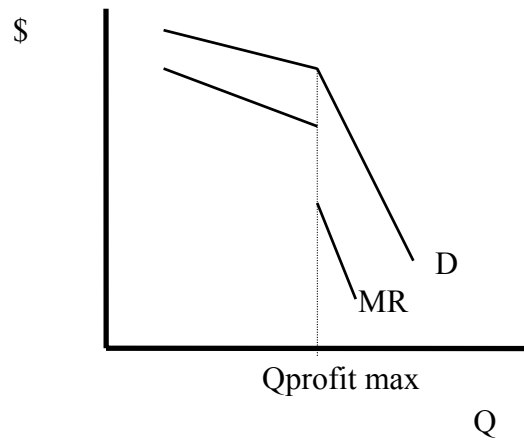
Analysis, please:

In this model there is fairly intense competition among firms. A single firm which dares to raise price will be “left out to dry” by the other firms and will lose market share, suffering a huge loss in demand because its competitors’ prices remain low. Conversely, a single firm that cuts prices will only see a small increase in demand and no increase in market share, as all of its competitors match the price reduction.

Graph:

*Demand curve:* A firm in a market such as this will have a kinked demand curve. The curve will be pretty flat above the current price, since a price hike results in a loss of market share. The curve will be pretty steep below the current price, since a price reduction results in no increase in market share.

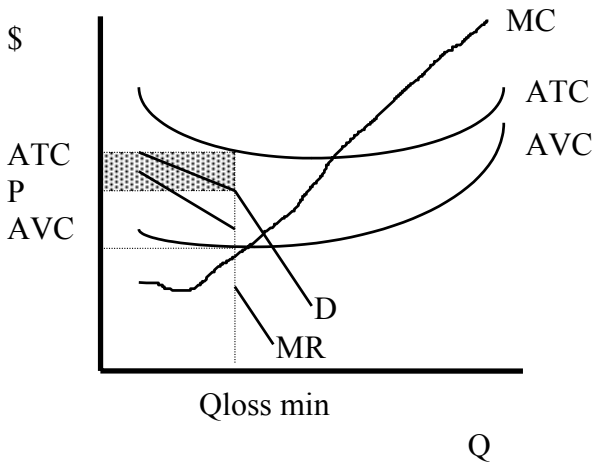
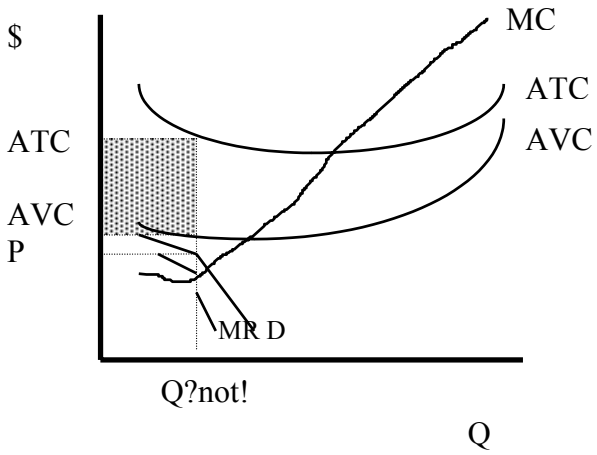
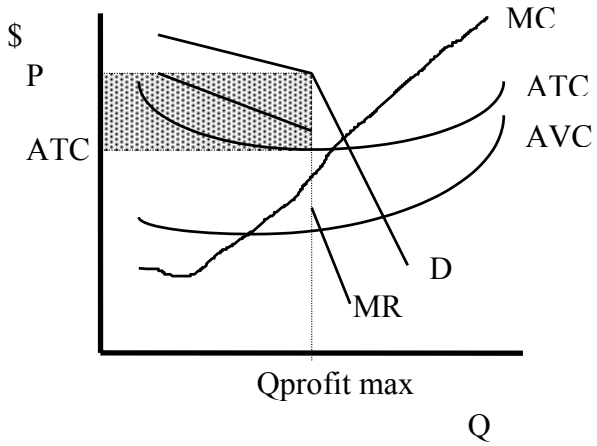
*Marginal revenue curve:* You might think that, since the demand curve is kinked, the marginal revenue curve will also be kinked. Hah! The laws of math dictate that there is a gap in the marginal revenue curve, directly below the kink in the demand curve.



Kinked Demand Curve Model continued: Short run performance

- 1) The firm may operate at a profit, if demand for the product is high relative to costs.
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Kinked demand curve and rigid prices:

In this kinked demand curve model it is usually folly for a firm to try to either raise its prices (and face loss of market share) or to lower its prices (and gain no market share). Hence the model predicts that prices should be fairly rigid—unchanging—in an oligopoly.

Problem: Real world oligopolistic markets rarely exhibit rigid prices, so we can dismiss the kinked demand curve model to depict most real world markets.

None of our models of oligopoly is satisfactory. Economists have turned to game theory to try to analyze oligopolistic markets.

## **Game Theory: An Introduction**

(More about game theory in another set of notes. Here, a brief introduction.)

Game theory had its genesis as a tool for gamblers to maximize their gain (or minimize their loss). In economics, one can model a market as a game, in which the players are the firms, and the object of the game is to maximize profits. One must impose a set of rules on the game; for example, one can prohibit collusion among players (i.e. prohibit a cartel). The course of the game and its ultimate outcome depend upon the strategies taken by the players and the rules imposed upon them; the course and outcome act as predictors of what might really happen in the market that one is modeling. (All of this can be done with mathematics.)

### **Nash Equilibrium:**

One way to predict the outcome of a game is to find a situation in which each player is doing as well as it can, *given what the other players are doing* (and given the rules of the game and the restrictions imposed on the actions of the players). This means that there is no incentive for any player to change what it is doing; we have an equilibrium, known as a Nash equilibrium.

### **Importance of model accuracy:**

It is important to model the market correctly—to impose a set of rules and strategies that truly reflect conditions in the market. As we shall see below, the outcome of the game depends crucially on the strategies imposed on the players and the rules imposed on the game.

### **Some Simple Games Modeling Duopoly:**

(A duopoly is a type of oligopoly in which there are only two producers)

Suppose we have a market with demand equation  $P = 300 - Q$ . There are only two producers, each identical, with marginal costs constant at 100.  $MC_1=100$  and  $MC_2=100$

What is the equilibrium in the market? It depends how we model it.

Model 1: The Cartel Game

Suppose we allow the firms to collude, jointly setting prices and production. (We will not, however, allow price discrimination; each unit of output sells for the same price per unit.) Then the firms act as though they are a monopoly with two plants, and they will maximize profits by following the same profit-maximizing rule that a multi-plant monopoly follows:

$$MR = MC_1 = MC_2$$

In our particular case, both MCs are constant at 100, and  $MR = 300 - 2Q$ . So:

$$300 - 2Q = 100 \rightarrow Q = 100$$

Combined production of the two firms totals 100. Price per unit is found using the demand curve:

$$P = 300 - Q = 300 - 100 = \$200$$

Model 2: The Cournot Game

Suppose now we have alternate assumptions. First, we outlaw collusion. Then, we stipulate that both firms must decide their levels of production simultaneously. Finally, we require each firm to compete based upon *quantity*; that is, each choose the quantity that maximizes its profits. (In this simple model, price is only of secondary concern.)

(Note: Let's use "Q<sub>1</sub>" to represent the units of output supplied by firm 1, and "Q<sub>2</sub>" to represent the units of output supplied by firm 2. Note that  $Q_1 + Q_2 = Q$ ; in other words, the sum of the output produced by the two firms equals the quantity supplied to the market. Let's further assume that the firms produce an identical product, so that each must charge the same price per unit, P.)

Clearly, the profit maximizing quantity of one firm depends upon the quantity produced by the other firm. Let's demonstrate this mathematically for firm 1:

Firm 1 maximizes profits by setting its marginal revenue equal to its marginal cost:

$$MR_1 = MC_1$$

We know that  $MC_1$  is constant at 100 because we have assumed this from the beginning. But what is  $MR_1$ ? Let's get an equation to represent  $MR_1$ . We will do this by

- (1) Getting a total revenue equation for firm 1, then
- (2) Differentiating the total revenue equation

- (1) The total revenue equation: (Let "R<sub>1</sub>" represent total revenue of firm 1.)

$$R_1 = PQ_1$$

From the demand equation we know that  $P = 300 - Q$

$$R_1 = (300 - Q)Q_1 \rightarrow R_1 = 300Q_1 - QQ_1$$

We know that  $Q = Q_1 + Q_2$

$$R_1 = 300Q_1 - (Q_1 + Q_2)Q_1 \rightarrow R_1 = 300Q_1 - Q_1^2 - Q_2Q_1$$

(2)  $MR_1$  is the derivative of  $R_1$  with respect to  $Q_1$

$$MR_1 = 300 - 2Q_1 - Q_2$$

Now let's get back to our profit-maximizing equation and try to figure out the profit-maximizing level of  $Q_1$ :

$$MR_1 = MC_1$$

$$300 - 2Q_1 - Q_2 = 100$$

$$2Q_1 = 200 - Q_2$$

$$Q_1 = 100 - .5Q_2 \quad \leftarrow \text{firm 1's reaction curve}$$

See how the profit maximizing level of  $Q_1$  depends upon the level of production by firm 2?

So how does firm 1 figure out how much to produce, since it doesn't know  $Q_2$ ? Well, it does know that firm 2 is identical to it, and that firm 2 will be doing the same types of calculations. We could do all of the calculations for firm 2, but by symmetry you can hopefully see that we'd get firm 2's reaction curve similar to firm 1's:

$$Q_2 = 100 - .5Q_1 \quad \leftarrow \text{firm 2's reaction curve}$$

So firm 1 can substitute information from firm 2's reaction curve, to calculate its own profit-maximizing level of production:

$$Q_1 = 100 - .5Q_2 \quad \text{now substitute info from firm 2's reaction curve}$$

$$Q_1 = 100 - .5(100 - .5Q_1) \rightarrow Q_1 = 100 - 50 + .25Q_1$$

$$Q_1 = 50 + .25Q_1 \rightarrow Q_1 = 66.667 \text{ (rounded)}$$

Firm 2 is identical to firm 1. We could do all of the calculations for firm 2, but hopefully you can see that by symmetry we'd get:

$$Q_2 = 66.667 \text{ (rounded)}$$

The market quantity,  $Q$ , is the sum of  $Q_1$  and  $Q_2$ :

$$Q = 66.667 + 66.667 = 133.333$$

We can now get the price from the market demand curve:

$$P = 300 - Q = 300 - 133.333 = 166.667$$

Compare our results to the cartel results. Same two firms, same demand curve, but different results, because we imposed different rules on the game and the players.

### Model 3: The Stackelberg Game

Lets' keep the same two firms and the same demand curve, and still outlaw collusion. But now, instead of the two firms deciding output simultaneously, let's let firm 1 decide output first (and firm 2 second). This will give firm 1 the advantage.

Recall firm 1's total revenue equation, which we derived in the Cournot game.

$$R_1 = 300Q_1 - Q_1^2 - Q_2Q_1$$

Here's an interesting fact. Firm 1 produces first, but it can do so with an accurate prediction of how much firm 2 will produce. How does it know? It knows that firm 2 will seek to maximize profits; firm 2 will see that firm 1 has already produced some output, and firm 2 will respond by producing the appropriate level of output—the level of output that will maximize its profits. In other words, firm 2 will follow its reaction curve:

$$Q_2 = 100 - .5Q_1$$

Well, firm 1 knows that firm 2 will do this, so firm 1 can substitute information from firm 2's reaction curve into its total revenue equation!

$$R_1 = 300Q_1 - Q_1^2 - (100 - .5Q_1)Q_1$$

$$R_1 = 300Q_1 - Q_1^2 - 100Q_1 + .5Q_1^2$$

$$R_1 = 200Q_1 - .5Q_1^2$$

We can now derive firm 1's MR curve, by taking the derivative of its total revenue equation:

$$MR_1 = 200 - Q_1$$

We can now calculate firm 1's profit maximizing level of output by setting its marginal revenue equal to its marginal cost:

$$MR_1 = MC_1$$

$$200 - Q_1 = 100 \rightarrow Q_1 = 100$$

We can now calculate firm 2's level of production by plugging in  $Q_1 = 100$  into firm 2's reaction curve:

$$Q_2 = 100 - .5Q_1 = 100 - .5(100) \rightarrow Q_2 = 50$$

Total production =  $Q_1 + Q_2 = 150$ . We can plug in  $Q = 150$  into the demand equation to get price:

$$P = 300 - 150 = 150$$

Notice, once again, that by changing the rules we changed the equilibrium. What fun! (I am especially having fun constantly formatting subscripts and superscripts. I love it!) Let's do it one more time!

#### Model 4: Bertrand Equilibrium:

Suppose we keep the same two firms, but assume that they compete viciously based on price—to heck with profits and quantity!

In this case, there's only 1 equilibrium—where  $P = MC$ , that is  $P=100$ .

Why? Well suppose you're firm 1 and think that  $P = 150$  is a good price. Well, firm 2 can charge \$149 and take away all of your business, since firm 2 produces an identical product. Indeed this is true if either firm sets a price above  $MC$ ; the other firm can undercut it and take away all of its business.

By the way, since  $P = 100$ , then using the demand curve,  $Q = 200$ .

By the way, in this case the outcome is socially efficient, since  $P = MC$ .

Do you see the importance of modeling a real world market correctly? Get the model wrong, and the results will be way off. Real game theoretic models of oligopoly are much more complicated than the ones shown here, but you get the idea. In the next set of notes we will discuss game theory more thoroughly.