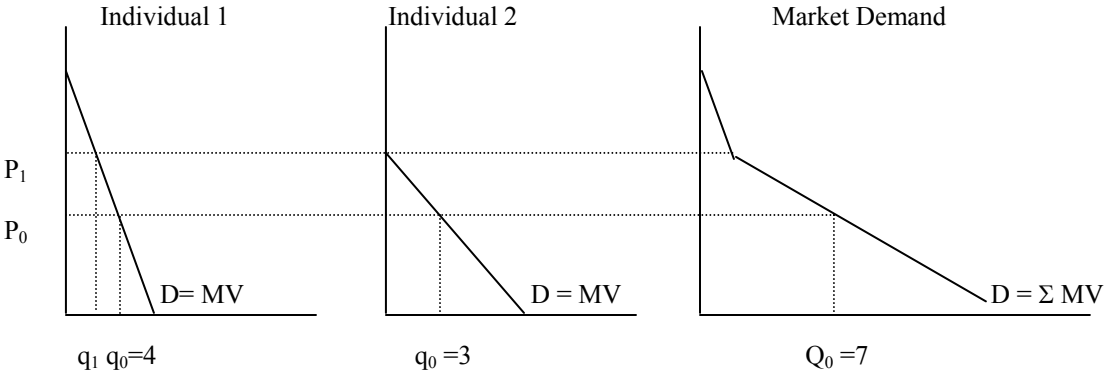
Horizontal Summation of Supply and Demand Curves (again)

Horizontal summation of supply or demand curves is very simple. Suppose we have two individual demand curves given below. To horizontally sum, we simply do the following experiment, and repeat it several times. Pick any price, P_0, find the quantity demanded by the first individual, then the quantity demanded by the second individual, and add them up. Then, the one of the points on the market demand curve will be P_0 and the sum of the quantities. Repeat for other prices, until you get bored.



For instance, if at P_0, the first individual demands 4 units, and the second individual demands 3 units, the market demand curve at P_0 would correspond to 7 units. (We'll use lower case qs to signify individual quantity demanded and uppercase Qs to show market quantity demanded). To remind us that a market demand curve is a horizontal summation of individual demand curves, we'll denote it D = Σ MV.

Suppose the price were P_1. The first individual would demand q_1 units, the second individual would demand 0 units. The market demand curve would be come from only individual one. In fact, at any price above P_1, the market demand curve would be identical to person 1's demand curve.

Price Takers

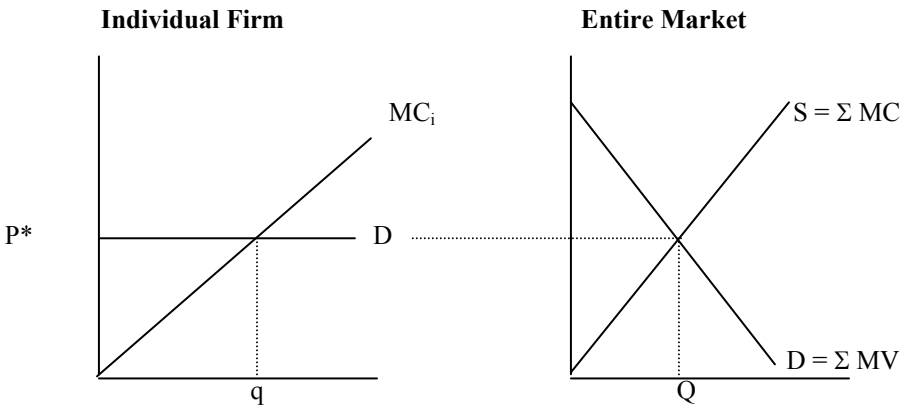
Thus far, we have implicitly assumed that firms are price takers. Essentially, we have assumed that each individual firm acts as if their output decisions do not affect the equilibrium (or market) price. The idea is that each individual firm is small relative to the market. One individual firm's decision to produce a few more units of output or a few less units of output will not affect the world price, as this one firm produces only a small portion of the world output of the good. They take the market price as given, and act as if it is out of their control. If one wheat farmer in Kansas produces a little more wheat, it will not change the world price of wheat. (Think of a very, very flat market supply curve.)

In a nutshell, price takers face a perfectly elastic (horizontal) demand curve for their good. The demand curve for the individual firm is horizontal (located) at the equilibrium price for the entire market. If they attempt to charge a price above P*, they lose all of their business to their many competitors. They can sell all of the output at P* that they want to, so they have no incentive to lower their price below P*.

World supply and world demand determine equilibrium price, and price takers accept this price as given.

On the right, we look at the market demand curve and the market supply curve, which gives us the equilibrium price, P*. On the left, we look at one individual firm, who takes the equilibrium price as given, and denote the quantity it produces with a lowercase q.

Since the market supply curve is the summation of all of the individual firm's supply curves, Q is the total quantity produced in the entire market. It is the sum of all the individual firm's levels of output. $Q = \Sigma q$.



Note, the two graphs are not drawn at the same scale. An individual farmer's (q) may be 1000 bushels of corn, while Q will be measured in the millions (?) of bushels.

So we use our standard decision rule. Price takers choose a rate of output such that P = MC. Now we know where the price comes from.

Price takers are often referred to as perfect competition. For this model to accurately represent the world, we'll have to assume that firms are small relative to the market and they sell homogeneous products. We basically assume that one firm's output decisions will not affect the market price.

This will not always be the case, that individual firm's output decisions do not influence the price. In some markets, one firm may produce a large fraction of the output of the entire market. Consider Microsoft. They produce 90% of the operating systems in the world. If Microsoft produces a bunch more copies of Windows, it will affect the equilibrium price of operating systems. Firms whose output decisions do affect the equilibrium price are called price searchers.

Price Searchers

Price searchers are said to have market power, which means they face a downward sloping demand curve. When price searchers choose different levels of output, this changes the price they will receive. They do not act as though price is given, but instead they can "search" for prices. They can choose any of several prices (and quantities) along their demand curve. Contrast this to price takers, who take price as given, out of their control. To make things clear, we will assume that there is only one firm that produces a good, called monopoly. In this case, as we shall see, it is clear that the firm's (monopolist's) output decision will affect the price. Thus, this firm faces no competition. It can raise its price without losing all of its business.

Consider first a numerical example. We will assume that somehow, we have figure out the demand curve for a product. There will only be one producer of the good (monopoly). We also know that TC for producing various levels of output for the firm. Given this information, we can calculate MC, TR, MR, and profits. The price searcher can choose any of the P, Q combinations along the demand curve. Of course, it wants to choose the combination with maximum profits.

P	Q	MC	TC	TR	MR	Profits (π)
10	1	2.5	2.5	10	10	7.5
9	2	3.0	5.5	18	8	12.5
8	3	3.5	9.0	24	6	15
7	4	4.0	13.0	28	4	15
6	5	4.5	17.5	30	2	12.5
5	6	5	22.5	30	0	7.5
4	7	5.5	28	28	-2	0

Notice the following:

Since the price searcher is the only producer of the good, it faces a downward sloping demand curve. It can choose any point on the market demand curve that it likes (It does not have to worry about a competitor offering a lower price for the good). That is, it can pick any pf the P, Q combinations in the above chart. It will choose the point on the demand curve that maximizes its profits. Of course, the costs of the firm will play a role. The firm can choose one unit of output and sell it a price of $10 (Profit = $7.5). If it wants to produce two units of output, the price will fall to $9 (Profit = $12.5). In order to sell additional units of output, it must lower the price to all consumers. (It can't sell to the first guy for $10, the second guy for $9, this is called price discrimination, more later?)

We haven't yet learned how to calculate **marginal revenue** (MR), but it is the same as calculating any other marginal quantity. Marginal revenue is just the additional revenue associated with producing one extra unit of output. One unit of output is sold for $10, two units of output generates $18 worth of revenue. Thus, the second unit of output has a marginal revenue of $8. ($18 - $10 = $8).

Price searcher's decision rule –
A price searcher will choose to produce at a rate of output where MR = MC. Notice, in the example above, MR = MC at 4 units of output. (Indeed, this chooses maximum profits.)

The firm maximizes profits by finding the quantity where marginal revenue, the additional revenue associated with producing one extra unit of output, equals marginal cost, the additional cost associated with one unit of output.

If the additional revenue from producing a unit were greater than the additional cost from producing an additional unit (MR > MC), they firm should produce more. They can increase profit by producing more.

If the additional revenue from producing a unit were less than the additional cost (MR < MC), the firm should produce less.

Where MR = MC is the optimal level.

Price Searchers graphically - and where is the MR curve?

We can do this more generally graphically. We already know how to graph a demand curve and marginal cost curves. Where do we put the marginal revenue curve?

Notice first, that marginal revenue is always less than price (demand). Why is this? See above chart and read the following. There are two things to consider. For an initial point of reference, suppose that the firm is producing 3 units of output at a price of $8 for TR = $24.

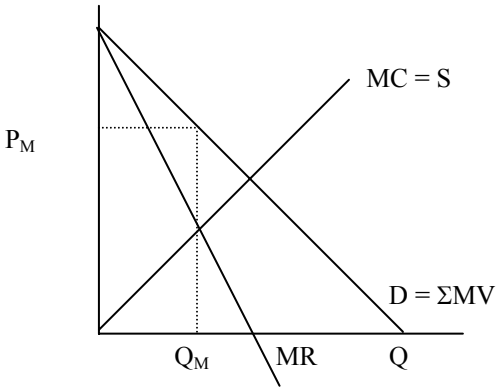
Suppose it is considering producing the 4^{th} unit of output. The demand curve tells the firm that it must lower the price to $7 to get consumers to purchase the 4^{th} unit of output. Two things simultaneously happen to total revenue. First, it sells one more unit of output at $7, and thus gains $7 in revenue from producing the 4^{th} unit. Second, however, to induce consumers to consume the 4^{th} unit, it must also lower the price on the three units it was already selling. Previously the firm was selling those first three units for

$8 a piece. It had to lower the price to $7 to induce consumer to purchase the 4th unit. Thus, it only takes in $21 on these first three units (which were previously bringing $24 of revenue). It loses $3 on revenue these first three units. The MR of the 4th unit is the sum of these two effects. +$7 (the price of the extra unit sold) – $3 (on previous units) = $4. (Does this seem vaguely familiar from our discussion of the elasticity of demand?)

As a result, we can draw the marginal revenue curve in. It is always below the price (demand curve) and can even have negative values (see chart above).

For linear demand curves (don't worry about why) it turns out the marginal revenue curve will begin where the demand curve intersects the vertical axis. MR intersects the horizontal axis at half the quantity where demand intersects the horizontal axis. It continues below the horizontal axis.

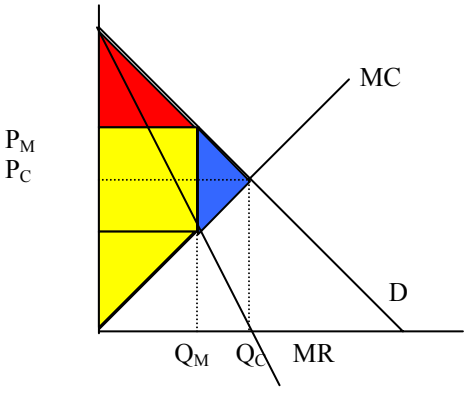
Graphically, the situation is as illustrated below. The price searcher chooses the output level where the MR curve intersects the MC curve. Then, at that quantity, the highest price consumers will pay is shown by the demand curve. We choose the quantity, then we scoot up (above the quantity) to the demand curve to determine the price that a price searcher charges.



Notice that at Q_M, MV > MC. We will have a DWL. Price searchers will not produce the efficient level of. output.

CS / PS / GFT / DWL

Below I have shaded in the CS, PS, and DWL. I have denoted the price searcher equilibrium P_M and Q_M (for monopolist) and also labeled the price taker equilibrium P_C and Q_C (for competition)



For the price searcher: CS in red, PS in yellow, DWL in blue.

You should compare the CS and PS that we would have gotten if the above firm were a price taker. You will find that CS is smaller and PS is larger for the price searcher.

Notice, that price searchers restrict output below the efficient level of output. We know from before that gains from trade will be maximized at the intersection of Supply and Demand. This is because at this point,

MC = MV. This was the result we got for price takers. Price searchers, however, produce less output than this. There is a dead weight loss.

The price searcher wants to raise the price of the good (to increase profits), but to do so he must restrict output. In the price searcher's quest to increase its own profits, it has the effect of restricting output below the efficient level for society. Price searchers are economically inefficient. Would I restrict output and raise price if I was a price searcher? Heck yeah.

Why doesn't the price searcher produce beyond Q_M? The answer is given by the marginal revenue and marginal cost curves. Marginal revenue is the additional revenue the firm will take in by producing one more unit of output, marginal cost the additional costs the firm will incur.

At an output above Q_M, MR < MC. The firm is losing money on these units. They should stop prior to Q*. Another way to see this in the following: Pick a quantity higher than Q_M and shade in the total cost of producing just the additional units beyond Q_M (the area under the MC curve) and the total revenue from producing just the additional units (the area under the MR curve). You will see that TC > TR (for these extra units). The firm would lose money on these extra units of output. This is exactly what the MR and MC curves tell us.

At an output level below Q_M, MR > MC. The firm is taking in more in revenue that it is incurring in additional costs. The firms should produce more. Again, if you don't believe me, shade in the total cost of producing some additional units and the total revenue from these units. TR > TC.

Some tidbits

One caveat, though. Being a price searcher does not necessarily guarantee positive profits. I am the monopoly producer of Chad Turner Sings the Blues Albums. Will this be a profitable activity? I doubt it. If you were in class, you may remember my idea for the club called "A wrinkle in time" (I'd prefer there be no written record of that example). How about a "Can of farts" producer being a price searcher?

Who are price searchers? They are producers of unique products and producers that are "large" relative to the market. Madonna is a price searcher. Microsoft is a price searcher. A Montana wheat farmer is not a price searcher. Ford is a price searcher, while the Betty Ford (clinic) is not a price searcher.

This decision rule of setting MR = MC seems to make a whole bunch of sense. Why don't price takers use it too?

Good question, I'm glad you asked. The answer is they do.

Recollect the way we came up with a supply curve. We assumed a market price of $7. (Though we didn't call it that at the time, what we were basically assuming was that the demand curve was perfectly elastic at a price of $7). Then we calculated all this stuff. The only thing we didn't do was look at marginal revenue, which I have added in the last column.

Q	TC	MC	TR	Profits	MR
0	$0	--	0	$0	--
1	$1	$1	$7	$6	$7
2	$4	$3	$14	$10	$7
3	$9	$5	$21	$12	$7
4	$16	$7	$28	$12	$7
5	$25	$9	$35	$10	$7

Notice, that for a price taker, MR is constant at $7, which was just the price (this is no coincidence). Thus, no matter what the quantity is, MR = $7. The marginal revenue curve is horizontal at a price of $7. But, the price taker faces a perfectly elastic demand curve (horizontal) at $7. Thus, the MR curve is exactly the same as the demand curve for a price taker.

You should go back to the graph of a price taker on page 2 of these notes, and note that the demand curve is the marginal revenue curve. You will then see graphically that MR = MC here as well.

Remember that the price taker assumes that he can sell as much output as he wants at the market price, in this case $7. The firm is small relative to the market, it's output decisions don't affect the world price. They don't have to lower the price on prior units to sell additional output. Since he doesn't have to lower the price to sell more output, the marginal revenue is no longer the sum of the two effect, it only the effect of selling one extra unit (= P). Marginal revenue is always equal to price.

In summary, both price takers and price searchers pick the quantity where MR = MC. For price takers MR = P, and thus, the MR = MC rule can be written P = MC (for price takers). The price taker rule (P = MC) is just a special case of the more general rule for which MR = MC.

All firms choose a quantity where MR = MC to maximize profits, whether they be price takers or price searchers. Price taker only choose a quantity where P = MC.

Check out your understanding on this stuff…

1. Confirm that a price taker indeed does pick an output level where MR = MC, but that a price searcher does not choose a level of output where P = MC.

2. Draw a market demand and supply curve. Consider the case where we have price takers to the case with a price searcher. Shade in CS / PS / DWL. Compare the sizes. Would consumers prefer to have a price searcher or price takers? How about producers? How about society as a whole?

3. For a price searcher, let Q_M be the profit maximizing level of output. Pick a slightly larger level of output. Can you shade in the total cost of producing (just) the additional units. Can you shade in the total revenue for the (just) the additional units? Which is bigger? Repeat for a slightly smaller (than Q_M) level of output.