

# 1 Market Structure and Firm Supply

We can now finally develop a framework to predict and describe how firms what to actually produce and put on the market.

But, how they behave turns out to depend on the market structure that they face! So we will develop a model first of how a firm might behave in a very competitive market (perfect competition) then how they behave with no competition (monopoly) and finish with how they behave with some competition (imperfect competition).

So up to this point in our theory of the firm we developed how firm's can best operate under technological constraints and input market constraints.

But, while firms can try and sell whatever it produces at whatever price it may decide, it can only sell as much as people are willing to buy (at that price) - so we have to bring the market right back into the picture.

## 1.1 Market Structure 1: Perfect Competition

This is a market situation characterized by:

- lots of firms
- all producing an identical product
- all take market prices as given
- perfect mobility of resources & easy entry and exit
- perfect information
- No market rivalry!

The first defining characteristic in a perfectly competitive market is that the demand curve facing any individual firm is not the market demand curve! Because the firm is a price taker, the demand curve is horizontal at the given market price. This means that in a P.C. market:

- firm thinks it will sell NOTHING if it charges above the market price
- firm is able to sell whatever it wants at the market price
- firm will get the entire market demand if it charges below market price

What about the supply curve?

Well, lets go back to our original choice problem to the firm:

- we assume firms maximize profits  $\pi$
- $\pi = R - C$

where costs are economic and include the opportunity costs of production.

Thus the decision making process of a firm boils down to some thing just like we had with the consumer: when making choices they weigh the additional benefits of a choice against the additional costs of the choice and when these additionals are equated their choice is optimal: so they just apply the economic decision rule as did consumers.

But what are the benefits and costs are to firms:

Benefits to firms =  $R = pq$  where (to a competitive firm)  $p$  is given by the market but they choose  $q$

Costs to firms =  $C$  and these depend on what is produced  $q$ !

To apply the economic decision rule we need marginal benefits ( $MR$ ) and marginal costs ( $MC$ ):

$$MR = \frac{\Delta R}{\Delta q} \approx \frac{dR}{dq}$$
$$MC = \frac{\Delta C}{\Delta q} \approx \frac{dC}{dq}$$

So the firm's optimal choice will be the  $q$  where:

$$MR = MC$$

i.e. to max profits firms will operate (produce) the amount where the extra revenue generated by one more unit of output just equals the additional cost of producing one more unit. If this expression is not held with equality, then a firm changes its output decision and increase its profits.

The question becomes, for a competitive firm, what are its  $MR$ ?

In a competitive market (perfectly) where the price the firm receives does depend on how many units that firm sells, the additional revenue they generate by producing and selling one more unit is simply the PRICE!!!!

So in a P.C. market,  $MR = p$

Go back to:

$$R = pq$$

and then

$$\frac{\Delta R}{\Delta q} = MR \approx \frac{dR}{dq} = p$$

So our condition for an optimal choice is simple: a P.C. will maximize their profits by producing the quantity that ensures:

$$p = MC$$

so the profit maximizing choice depends on  $p$  and the  $MC$  function. Basically what the condition does is determine  $q$  for every combination of  $p$  and  $MC$ .

I am hoping this sounds familiar to you - something that tells us how much to produce for any  $p$  given our costs?

I am sure it is familiar because all we are talking about here is the **supply curve!!!!!!!!!!!!!!!!!!!!!!** The point is that the firm's  $MC$  curve just traces out its supply curve, apart from two exceptions:

1. If there are two levels of output where  $p = MC$  - we rule out levels of output where  $MC$  slopes downward; this makes sense because at these point an increase in output MUST increase profits. So we just rule out this region, and define the supply curve of a competitive firm to lie along the upward sloping section of the firm's  $MC$  curve.

2. Shut down condition. This is a SR phenomena, and occurs when your profit max choice is to shut down and incur negative profits (which are the best you can make, by definition).

We know that in the SR:

$$\Pi^{SR} = pq - VC(q) - FC$$

if

$$q = 0 \rightarrow \Pi^{SR} = -FC$$

Lets define that the firm is better off going out of business ( $q = 0$ ) when the profits from  $q = 0$  are greater than those when producing at  $p = MC$ .

i.e.

$$\text{if } \{\Pi^{SR} = -FC\} > \{\tilde{\Pi}^{SR} = pq - VC(q) - FC\} \text{ then shutdown}$$

so if we take this and rearrange it:

$$\text{if } \{-FC\} > \{pq - VC(q) - FC\} \text{ then shutdown}$$

or

$$\text{if } 0 > \{pq - VC(q)\} \text{ then shutdown}$$

$$\text{if } VC(q) > \{pq\} \text{ then shutdown}$$

$$\text{if } \frac{VC(q)}{q} > p \text{ then shutdown}$$

and as  $\frac{VC(q)}{q} = AVC$  then our shutdown condition is simply that a firm should shut down in the SR if, at the  $q$  in question,  $p < AVC$ ! Thus the shutdown price is the price for profit maximizing  $q$  when  $p^{SD} = AVC$ . Given what we know about the geometry of the problem, then the shutdown condition is defined by the market price  $p = p^{SD} = AVC$  and as we know the firm will max profits by choosing  $q$  such that  $p = MC$ , then we know that:

$$p = MC = AVC$$

and this will only be at one point, where  $AVC$  are at their minimum. So the shutdown condition is simply:

$$p^{SD} = MC = \min AVC$$

This is of course because the firm's revenues from sales do not cover the variable costs, best then to just pay the fixed costs.

So if we combine these two conditions **the individual firm's supply curve in the SR is its MC curve above the point where  $p = AVC$ .**

Of course this however leads us to another definition: if firms start producing and selling in the SR if the price they receive exceeds their  $AVC$  from producing their profit max  $q$ , then they may earn negative, zero or positive profits. What will tell us which of these the firm earns is another simple intersection, but of what?

The point we wish to find is the breakeven price, that which allows a firm to cover both fixed and variable costs, and make exactly zero profit. If the price the firm receives is above this, great and the firm makes profits. If the price the firm receives is below this, the firm either makes negative profits (losses) or shuts down. To find this price, lets go back to our definition of profits:

$$\Pi^{SR} = pq - VC(q) - FC$$

and we know that at the breakeven price,  $\Pi^{SR} = 0$  so:

$$\Pi^{SR} = pq - VC(q) - FC = 0$$

so to find that price:

$$\begin{aligned} pq - VC(q) - FC &= 0 \\ pq &= VC(q) + FC \end{aligned}$$

or

$$p^{BE} = \frac{VC(q) + FC}{q}$$

which is pretty familiar again (or should be by now) as the RHS is just  $\frac{VC(q)+FC}{q} = AC^{SR}$ , so the breakeven price in the short-run is  $p^{BE} = AC^{SR}$ . Again we are able to define this condition easily because we know the firm maximizes profits by choosing  $q$  such that  $p = MC$ , then we know that:

$$p = MC = AC^{SR}$$

and this will only be at one point, where  $AC$  are at their minimum. So the breakeven condition is simply:

$$p^{BE} = MC = \min AC^{SR}$$

So there are two basic questions in the SR: (1) should the firm produce or shut down? If  $p > p^{SD} = \min AVC$  then operate, and if so, (2) then choose the profit max  $q$  by  $p = MC$ . Whether the firm makes profits or losses or just breaks even just comes down to a comparison of the market price and the breakeven price.

Now if we move to the LR, what changes? Again the firm's  $MC$  curve is their supply curve, however now there are no  $FC$  so there is no shut down condition. However, in the LR, what can firms do? Change anything, thus they can EXIT the market and not face the fixed costs at all. So in the long run there are again two choices facing the firm, but with a subtle difference:

- (1) they first choose whether to stay in the market or exit
- (2) and if they stay, how much to produce?

To answer the first LR question in this P.C. setting the choice is simple: if they at least breakeven in the LR they will stay in the market. If they make LR losses they will exit. But, if they are making LR profits you should realize that as a competitive market with no entry or exit barriers NEW ENTRANTS ENTER! So in the long-run the market can fundamentally adjust (in terms of number of firms) over time. This has market consequences of course and we will return to this, but for the moment what we have to figure out, in the LR, what defines the firm breaking even?

Again, lets return to the profit expression (just in the LR):

$$\Pi^{LR} = pq - C(q)$$

And we know the firm will breakeven when  $\Pi^{LR} = 0$  so:

$$\Pi^{LR} = pq - Cq = 0$$

or

$$\begin{aligned} pq &= C(q) \\ p^{BE} &= \frac{C(q)}{q} \end{aligned}$$

Which again defines the breakeven price (now in the LR) as the price that equals AC  $p^{BE} = AC = \frac{C(q)}{q}$ . Again, as we know the firm will maximize profits by choosing the  $q$  such that  $p = MC$  then we know:

$$p = MC = AC$$

and as know  $MC = AC$  at the min  $AC$  then the LR breakeven condition is:

$$p^{BE} = MC = \min AC$$

1. If the price the firm receives is above  $\min AC$  the firm will make profits which serve as a signal to potential entrants.

2. If the price the firm receives is equal to  $\min AC$  then the firm makes zero profits and there are no signals for profit opportunities.
3. If the price the firm receives is below  $\min AC$  then the firm makes losses and some firms will not bear these and exit.

These three potential outcomes drive market dynamics as all firms in the market are identical and there are no barriers to entry or exit. But first, we have to think about market supply curves.....

### 1.1.1 Short-run Supply

The short-run industry supply curve is simply calculated by adding up what each individual firm is willing to produce at each price because we know that in the SR:

1. some inputs may be fixed
2. firms may face fixed costs
3. entry and exit are not possible so the number of firms in the industry is fixed
4. each individual firm's supply is its MC curve above the shut-down point

Of course, as the possibility exists that some firm's have different cost curves than others, different firms may have different shut-down prices. In general then at low prices fewer firms will produce than at higher prices, making the industry supply curve more elastic than the individual supply curves of firms.

### 1.1.2 Short-run Equilibrium

As we developed above, individual firms in P.C. markets will choose their  $q$  to maximize profits by selecting the level where  $p = MC$ , which is where the individual firm's demand curve (its MR which we know is its price) equals its supply curve (its MC). In a P.C. industry, each firm will operate according to this rule where demand equals supply, so that at the industry level, industry supply (the summation of individual supply curves) equates the industry demand, which is the summation of all demands of firms in the industry. This result, that industry prices and quantities are determined by the intersection of supply and demand, is precisely Adam Smith's invisible hand leading to the equilibrium outcome.

We can investigate how changes in important characteristics change the short-run equilibrium:

- a. Changes in fixed costs?

Answer: Has no effect and they are fixed in the SR anyway!

- b. Changes in variable costs?

Answer: This might reflect an increase in the price of a variable input (i.e. increase in the wage rate, or a tax on the firm's output that the firm pays per

unit produced). What the increase in variable costs does is to shift the SRMC curve up!

1. Start in SR equilibrium:

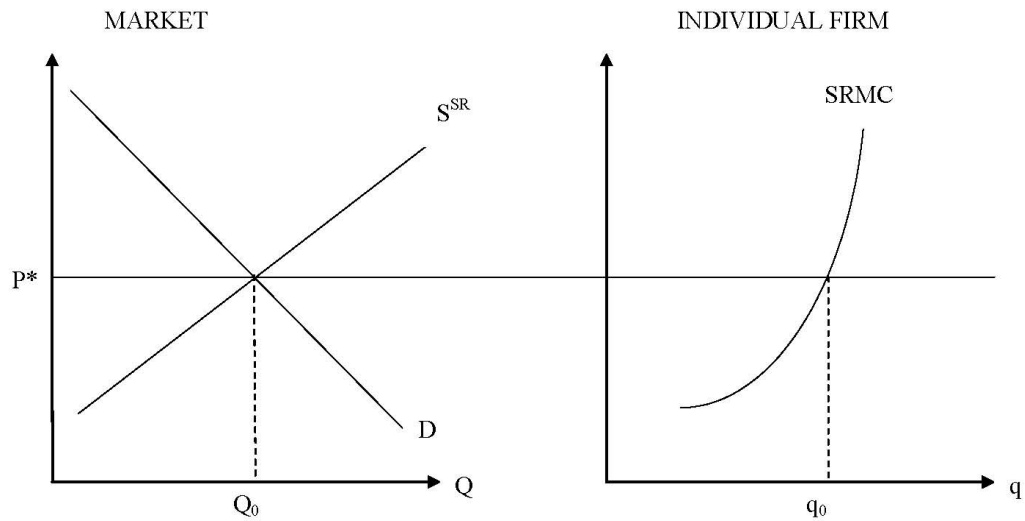


Figure 1: Initial SR equilibrium

2. An increase in variable costs shifts up the MC curve (and of all firms in the market).

3. As soon as the SRMC curve shifts up, the firm's optimal choice drops (at  $p_0$  to  $q'_0$ ) and simultaneously the market supply curve shifts up to  $S_1^{SR}$  (which is the summation of all individual firm's supply curves, all of which have shifted up) with a lower market supply (at  $p_0$ ) of  $Q'_0$ .

4. Of course this is not an equilibrium, because at that low quantity demanders are willing to bid up the price for the limited units - seen in the movement to a new market equilibrium.

5. With new market price, there is a new optimal choice for the firm, where (only due to how I sketched the shift) in this case the quantity supplied by the individual firm is lower than before the variable price change (it might be lower, greater or equal depending on the MC shift).

6. Overall:  $\uparrow VC \Rightarrow SRMC \uparrow \Rightarrow S^{SR} \uparrow \Rightarrow p \uparrow, Q \downarrow, \&q \uparrow \downarrow$

c. Changes in demand?

Answer: Increase in demand results in an increase in the price, results in a rise in  $q$

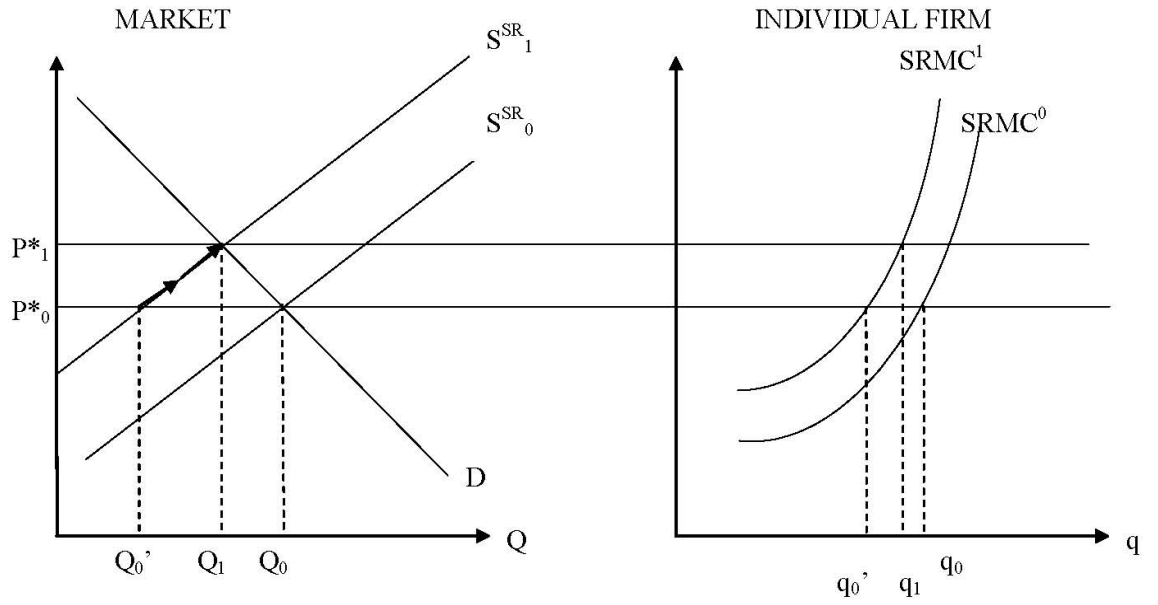


Figure 2: SR effect of an increase in VC

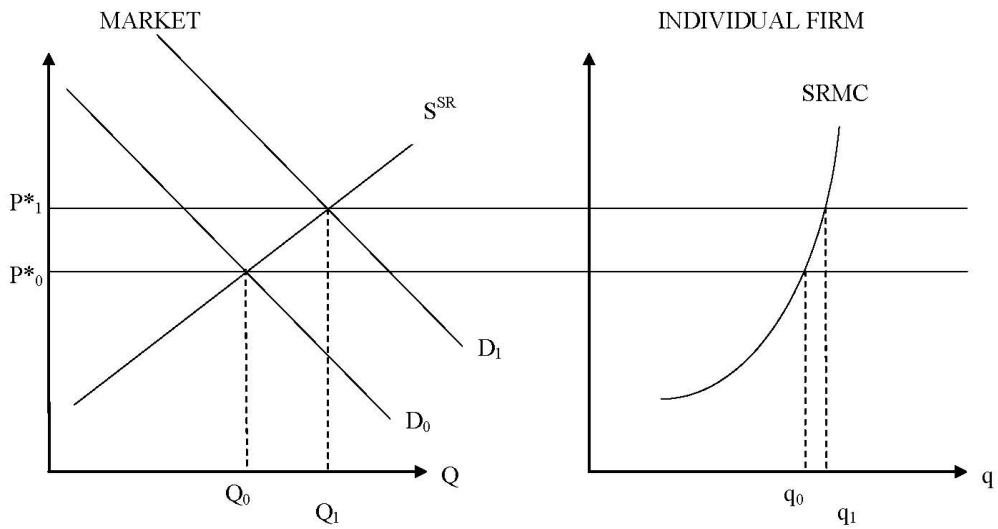


Figure 3: SR effect of an increase in demand



### 1.1.3 Long-run Supply

As we now know well, in the long-run all inputs are variable (i.e. there are no fixed costs) and firms may enter or exit. These two features are very important in deriving the firm's long-run supply curve and the industry's long-run supply curve.

We already know that firm's will max profits by selecting their output such that  $p = MC$ , and in the LR the only thing that changes is that it is the *LRMC* curve we are referring to. How the LRMC are related to the SRMC are important.

Example: Rose's

For the effect of a change in demand, lets us an example of Rose's diner.

Rose produces hamburgers using inputs of ground beef, short-order cooks and kitchen grills (fixed in SR).

How does Rose responds to an increase in the price of hamburgers?

In the SR she can increase  $q$  to  $q'_0$  by buying more groundbeef and hiring more cooks, operating on her SRMC curve:

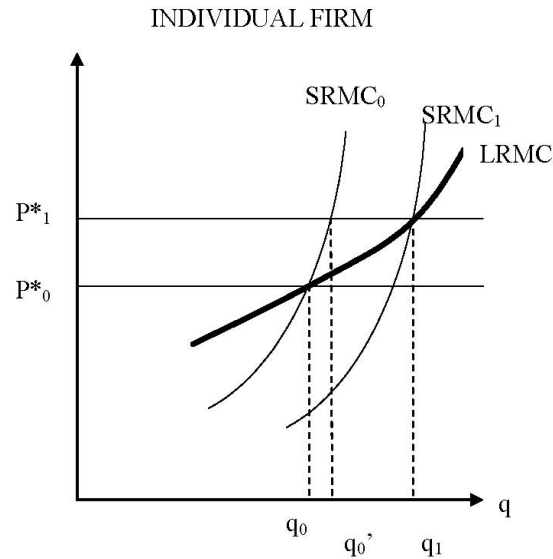


Figure 4: Rose's Diner Responses to increase in price

But, in the LR Rose can increase the number of grills she has, moving to a new SRMC curve, with new optimal choice of  $q_1$ . Thus the LRMC curve is found! But what I have glossed over here is WHY the LRMC curve above slopes up (which of course implies that the  $S^{LR}$  slopes up)? Well this relates to whether or not the movement to the new SR curves includes changes in the cost

structure of firms, or if they remain the same! This is of course very important because this is how we determine the industry long-run supply curves  $S^{LR}$ .

**Supply in a constant cost industry** The point is that when an industry

expands or is entered (or exited) by new firms in the transition from the SR to the LR then if the cost structure of the expanded firms or new firms is exactly the same as before, then we have a **constant cost industry**. The easiest way to think about this is that new entrants all have the same breakeven price. As new entrants enter or firms expand capacity, the BE price remains the same (i.e. individual firm costs curves remain constant)! Thus the  $S^{LR}$  is **flat**:

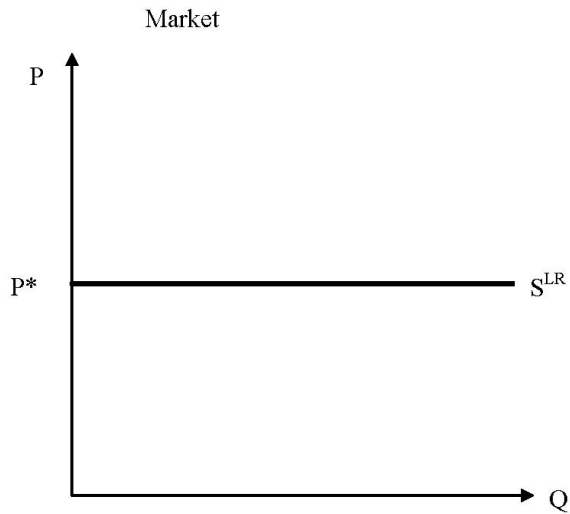


Figure 5: Constant cost LR supply

**Supply in an increasing cost industry: increasing curve** As new entrants enter or firms expand capacity, the BE price for all firms rises (i.e. individual firm MC and AC curves rise with new entrants); this is due to either efficiency effects or the factor price effect. The efficiency effect is just that the most efficient firms are already in the industry and that new entrants are not able to produce as efficiently and cause  $S^{LR}$  to slope upwards. The factor price effect is that in cases where all firms are equally efficient, but as firms enter or expand capacity the prices of inputs are bid upward - shifting SR cost curves

upwards (i.e. with entry or expansion the breakeven prices rise). The result of either of these effects is that  $S^{LR}$  in the industry slope upward:

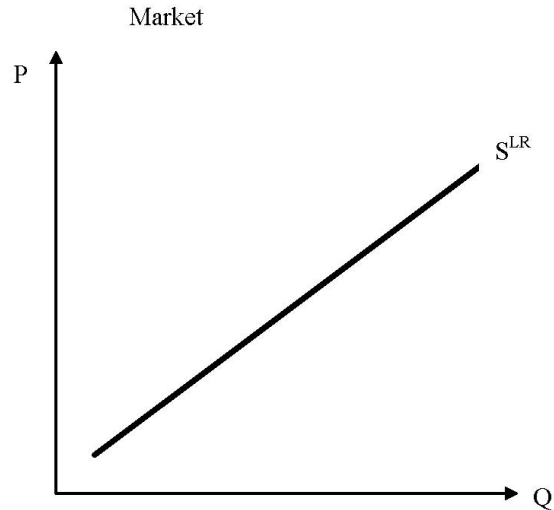


Figure 6: Long-run supply in an increasing cost industry

**Supply in a decreasing cost industry: decreasing curve** As new entrants enter or firms expand capacity the BE price for all firms falls (i.e. individual firm MC and AC curves fall with new entrants); may be due to efficiency and factor price effects (ie the bigger the industry the more specialized suppliers become and can provide inputs cheaper so costs fall, the BE price falls). The result are that  $S^{LR}$  in the industry slopes downward:

So the first difference between the SR and LR concerns the LR adjustment of inputs that are fixed in the SR.

The second difference between the SR and LR is the firm's decision to produce at all, and in the long-run firms not only shut down, they exit! What triggers the exit (or the flip side, then entry) of a firm out of (or into) a P.C. industry are the LR economic profits that firm's are earning in the industry. Remembering that economic profits include the opportunity costs of a firm's decisions (i.e. what they could make using the resources in their next best use), then if a firm is making LR negative profit they are making less that they could in some other industry (by definition of opportunity costs) and they may choose to exit the industry. If they are breaking even in the LR then the stay in the industry and produce (remembering that they are making zero economic profit

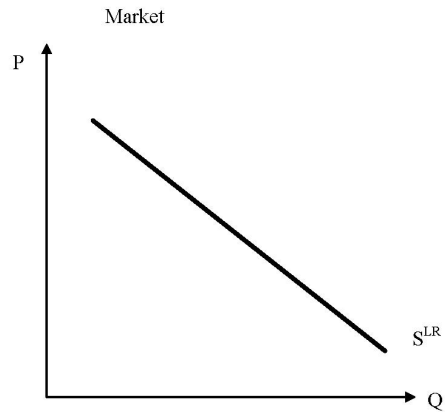


Figure 7: LR Supply in a decreasing cost industry

just means that they are doing no better, but no worse than they could in another industry), but if they make LR positive profits they will not only stay in the industry, the profits will serve as a signal to entrepreneurs to enter the industry to get some of the positive profits.

#### 1.1.4 Long-run Equilibrium

Equilibrium in the LR now means a lot more than equilibrium in the short-run, because of the possibility of changes in the number of firms in an industry (as well as changes in the amount supplied and price of the good). In the long-run, it is the process of entry and exit and how this influences the market that defines the concept of LR equilibrium. Returning to our algebra above, we know that LR-equilibrium will be a situation when there is no entry or exit into or out of the industry, which is when firms in the industry break even or when:

$$p^{BE} = MC = \min AC$$

for all firms in the industry. While LR-equilibrium is point of balance or stability, how the industry gets there depends on the characteristics of firms in the industry and those that enter (or exit).

**Long-run equilibrium - constant cost industry** This is easy to see if all firms have the same cost structure and these costs do not change as the industry expands or contracts. This is what characterizes a constant cost industry, and it is characterized by a flat LR supply curve.

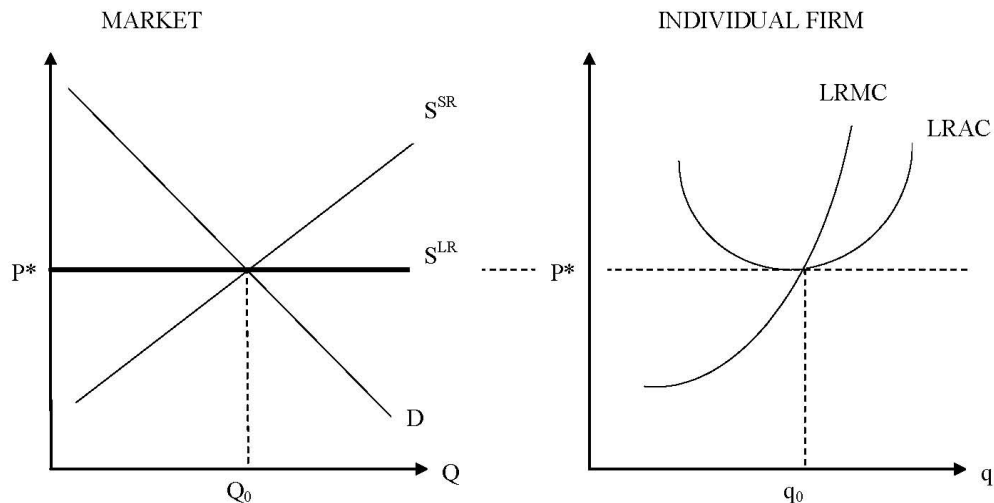


Figure 8: LR Equilibrium - constant cost industry

Constant cost industry and:

a. Changes in fixed costs

FC do not effect MC but they do influence the AC curve and change the BE price.

If FC were to be increased:

1.  $\uparrow FC \Rightarrow \uparrow AC$
2. Have a new BE price, firms make losses at  $p_0^*$  and some exit.
3. As firms exit the  $S^{SR}$  and  $S^{LR}$  curves shift upwards, increasing  $p^*$ .
4. Exit continues until  $p_1^* = MC = \min AC_1$
5. Overall:  $Q \downarrow, P \uparrow, q \uparrow \ \& \ N \downarrow$  (where  $N$  is the number of firms in the industry)

b. Changes in variable costs

Changes in VC have two effects on the firm - they change both MC and AC.

For an  $\uparrow$  in VC:

1.  $\uparrow VC \Rightarrow \uparrow MC \ \& \ \uparrow AC$ .
2. Have a new, higher BE price, firms make losses and some exit.
3. As firms exit the  $S^{SR}$  and  $S^{LR}$  curves shift upwards, increasing  $p^*$ .
4. Exit continues until  $p_1^* = MC = \min AC_1$
5. Overall:  $Q \downarrow, P \uparrow, q \downarrow \ or \ \uparrow \ or \ -$  (in this case  $q \downarrow$ ),  $\& \ N \downarrow$  (where  $N$  is the number of firms in the industry)

c. Changes in demand

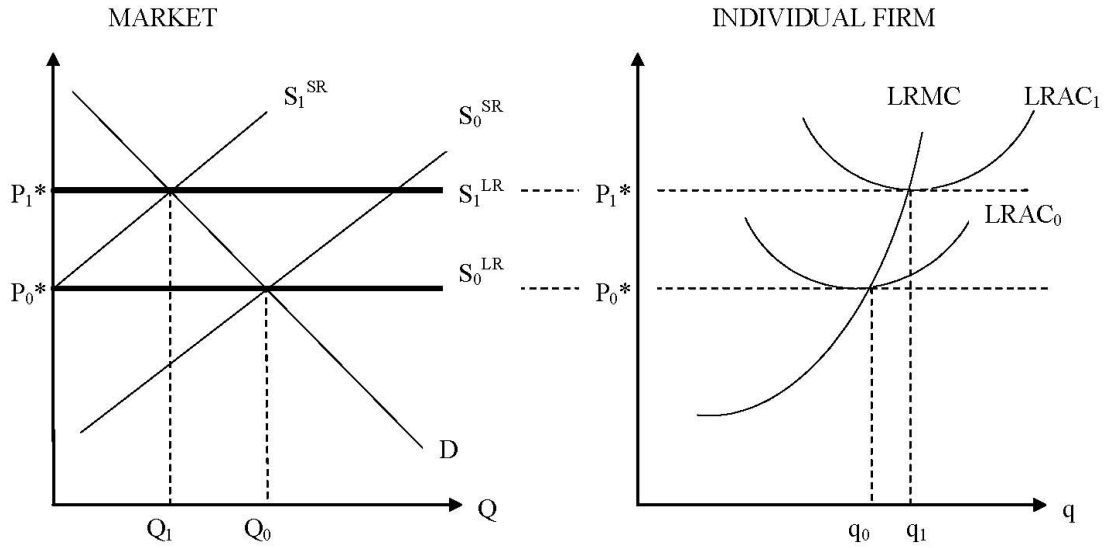


Figure 9: Increase in FC in a constant cost industry

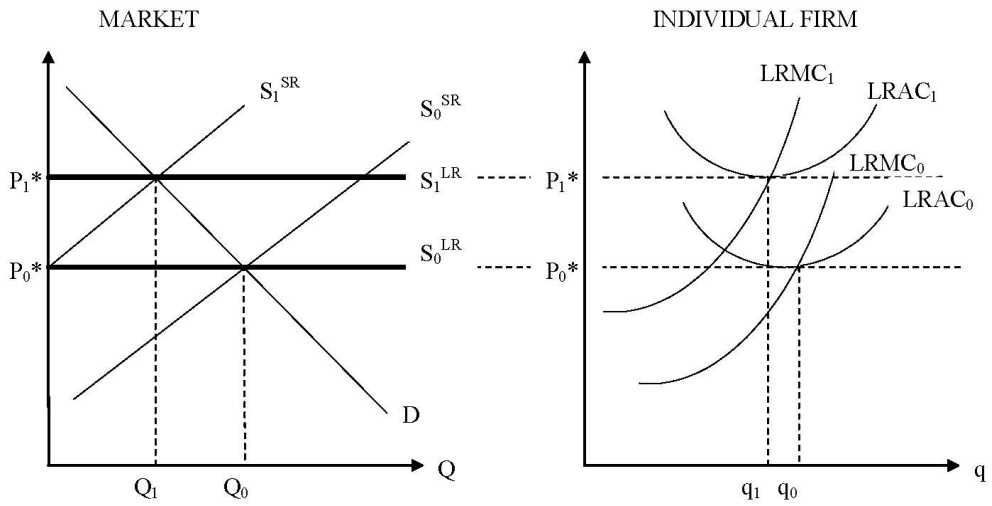


Figure 10: Increase in VC with a constant cost industry

A change in demand seems like it would be simple as  $Q$  and  $N$  might be the only variables that adjust. But when one gets into it deeper there is a lot going on:

Consider an increase in demand:

1.  $\uparrow D \Rightarrow$  in SR as  $N$  is fixed, the price is bid up to  $p_1^{SR}$  and  $Q \uparrow$  to  $Q_1^{SR}$  and  $q$  increases to  $q_1^{SR}$ :
2. As firms are earning profits, in the transition to the LR - there is entry and  $N \uparrow$ .
3. As  $N \uparrow \Rightarrow$  shifts  $S^{SR}$  out, which puts a downward pressure on  $p$ .
4. Entry continues until  $p$  returns to  $p^*$  and so  $q$  returns to  $q^*$ .
5. Overall:  $\uparrow D \Rightarrow Q \uparrow, \bar{p}, \bar{q}, \& N \uparrow$ :

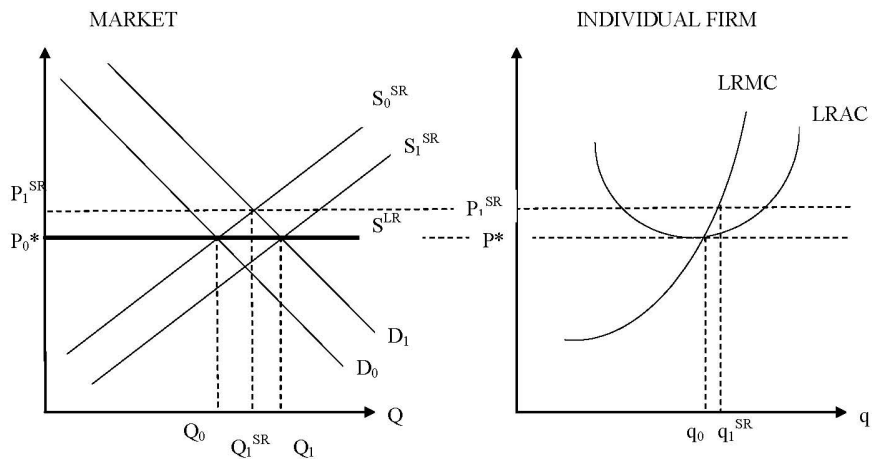


Figure 11: Increase in demand, constant cost industry

**Long-run equilibrium - increasing cost industry** If firms differ in their cost structure and if the break even price of new entrants increases as the industry expands, the industry has increasing costs and is characterized by an upward sloping LR supply curve.

In general there are two reasons why an industry has increasing costs:

1. Firms not currently in the industry (but that might enter if price goes up) have higher breakeven prices because they are less efficient than firms currently producing in the industry.
2. Even if (1) does not hold and all firms are equally efficient, they may have effects on factor prices - as more firms start to produce they demand more of some factors and drive up these factor prices - which drives up the breakeven price for ALL firms in the market.

Increasing cost industry and:

- a. Changes in fixed costs
- b. Changes in variable costs
- c. Changes in demand

**Long-run equilibrium - decreasing cost industry** Example - decreasing

average cost of laptops (2001 - \$1640 to 2005-\$1000 or less)

In the case of an industry with decreasing costs, the breakeven price of new entrants falls as the industry expands, so it is characterized by a downward sloping LR supply curve. One of the primary reasons we see this is that as an industry expands it may become more efficient or suppliers may become more specialized and able to provide factors at lower prices (relying on small margins at high quantities).

Decreasing cost industry and:

- a. Changes in fixed costs
- b. Changes in variable costs
- c. Changes in demand