The Firm and the Industry under Perfect Competition

The decisions of firms depend on consumer demand and production costs. Yet, they also depend on the behavior, the number, and the size of other firms in the industry.

The degree of competition that firms face can severely limit the choices that firm owners have in setting prices. This can protect the interests of consumers. For example, the U.S. automakers have faced increasing competition from Japanese and German automakers. This forced the U.S. firms to produce cheaper, safer and more reliable cars which benefits consumers.

Chapter 9 examines firms under severe competition while chapter 11 illustrates monopoly firms that face no competition.

Industries differ dramatically in the number and average sizes of their firms. For example, the fishing industry contains many small firms, whereas the aircraft and telecommunications industries are comprised of a few giant firms.

Chapter 9 describes perfect competition wherein firms are numerous and small.

First, we will discuss various market forms.
Second, we will analyze the output decisions of perfectly competitive firms.
Third, we will consider how developments in the industry affect individual firms.

Types of Market Structure

A market is a set of sellers and buyers whose behavior affects the price at which a good is sold.

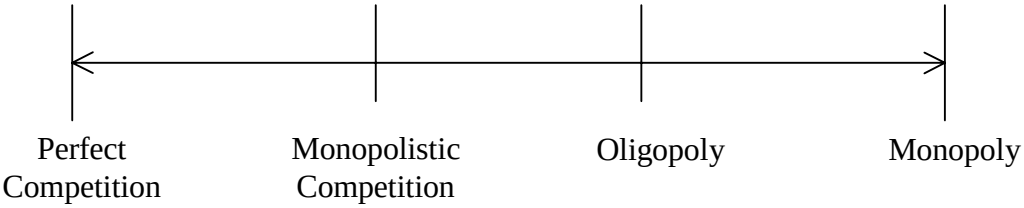
> For example, Cisco stock sold in California and Wisconsin is considered to take place in the same market, so markets don't necessarily refer to a geographical area. If you bought Ben and Jerry's ice cream and a package of Rayovac batteries at a local Ralphs store, then you are transacting in two different markets.

In the next two chapters we'll see that the type of market a firm operates in, has a large impact on the firm's behavior. Firms have no control over price under perfect competition. But, firms have tremendous control over price in a monopoly setting.

Economists describe different types of markets by:

(1) the number of firms
(2) whether the products of different firms are identical or different
(3) how easy it is for new firms to enter the market.

The 4 major types of markets can be viewed on a continuum.



Perfect competition is at one extreme with many small firms selling identical products. Monopoly is at the other extreme with one firm. The intermediate cases are monopolistic competition involving many small sellers producing slightly differentiated products and oligopoly, which has a few large firms.

> Question: Can you give an example for each type of market? To which market do most U.S. industries belong?

There are 4 conditions required for perfect competition.

(1) Numerous small firms and customers -- the decisions of individual producers and buyers does not impact the price of the good.
(2) Homogeneity of product --products offered by sellers are identical. For example, wheat of a particular grade is homogenous, while ice cream is not. Consumers don't care from which firm they buy the good because their products are identical.
(3) Freedom of entry and exit --there are no barriers to enter the industry, so a new firm does not have to match the advertising of the existing firms to secure customers. Nor are there large sunk costs that require large investments in equipment before production can start. There is also freedom to exit, so firms can leave the industry if the business proves unprofitable.
(4) Perfect information --each firm and customer is well informed about the prices and products. They know if one seller is offering the product at a lower price.

These conditions are infrequently met. A good example is a company's stock. There are millions of buyers and sellers, the shares are identical, entry into the market is easy, and information about the price of the stock is available over the Internet. Other examples include fishing and farming.

If this market is so rare, then why are we bothering to study it? Perfect competition is a benchmark --it is the standard by which all other markets are judged. We will see that markets work most efficiently under perfect competition. It insures that the economy produces what society wants using scarce resources most effectively. By studying perfect competition, we will see what an ideally functioning market system can accomplish. In chapter 11, we will see how far monopolies deviate from this ideal.

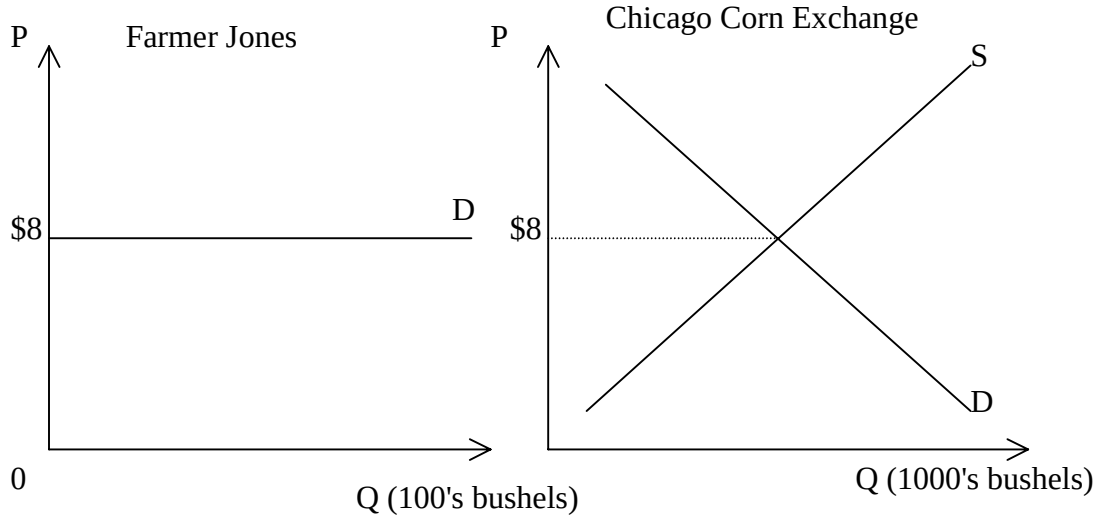
The Competitive Firm and its Demand Curve

Under perfect competition, the firm must accept the price determined in the market. The firm is a price taker --it can produce as much or as little as it likes without affecting the market price.

> Each firm must match the price offered by its competitors because the products are identical. Otherwise, consumers will shift their purchases to another firm.

The industry, which is comprised of all the individual firms, can impact the price through the forces of supply and demand.

Consider the shape of the demand curve faced by a perfectly competitive farm.



Farmer Jones has a horizontal demand curve because she can sell as much or as little as she likes at prevailing market prices. She can double or triple her production and it has no effect on the price of corn. Thus, Jones is insignificant to the market exchange in Chicago. She must accept the price that a broker quotes her. There are thousands of other corn farmers, so if Jones doesn't like the price and holds back her production, it won't effect the market price.

Short Run Equilibrium of the Perfectly Competitive Firm

Consider the relevant data for a perfectly competitive farmer.

Quantity (1,000's bushels)	Total Revenue ($1,000's)	Marginal Revenue ($1,000's)	Total Cost ($1,000's)	Marginal Cost ($1,000's)	Total Profit ($1,000's)
0	0	------	0	------	0
10	80	80	85	85	-5
20	160	80	150	65	10
30	240	80	180	30	60
40	320	80	230	50	90
50	400	80	300	70	100
60	480	80	450	150	30
70	560	80	700	250	-140

If the price is $8 per bushel, then total revenue (TR) is simply $8 x Q.

Marginal revenue (MR) is the change in TR when output increases by 1 unit. We have "cheated" in the table above because output doesn't increase by 1 bushel, it increases by 10,000 bushels. So MR reflects the increase in TR when output increases by 10,000 in our example. Note that MR is equal to price *if* the demand curve is horizontal. If the output increases by 1, then the firm still receives the same price.

As before, TC and MC reflect input quantities and prices. Profit is simply TR-TC.

The farmer will seek the output level that maximizes her profits. This occurs when TR and TC are furthest apart at the output of 50,000 bushels. There is a rule for determining the level of output that has the highest possible profit. This rule holds true for all firms and not just those under perfect competition.

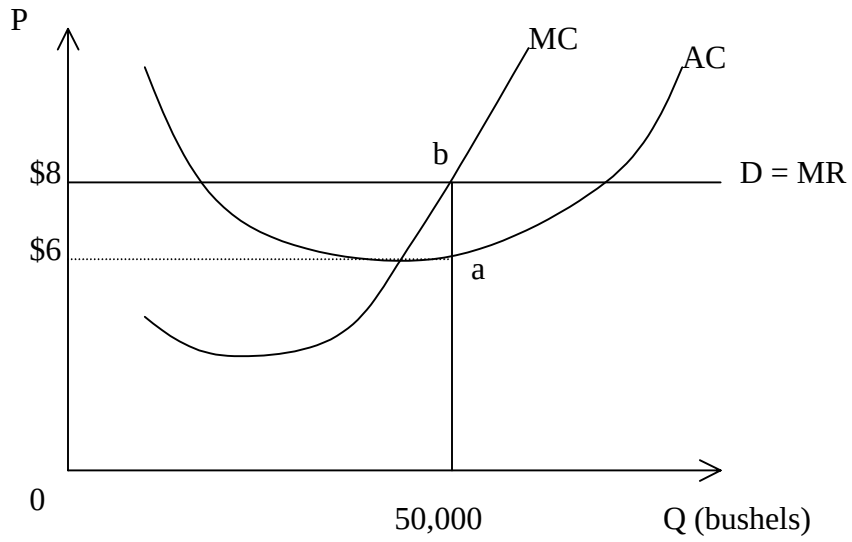
Rule for finding the profit maximizing level of output

If MR > MC, then profit can be raised by increasing the quantity of the output.
If MR < MC, then profit can be raised by reducing the quantity of output.
Thus, the highest profit is attained at the output level where MR = MC.

> Our example shows that profit is highest when MR ≥ MC at the output of 50,000 bushels. If the next 10,000 bushels gets produced, profit will fall by $70,000 because the MR is $80,000 while the MC is $150,000.

Since MR = price (P) under perfect competition, the perfectly competitive firm will choose the output where MR = P = MC where profits are maximized.

Consider the graphical representation of short run profit.



The firm produces an output of 50,000 bushels where P = MR = MC, at point b. To measure profit graphically, we compare the height of the demand curve with the height of the AC curve.

Recall:

Profit = TR - TC
TR = P x Q
TC = AC x Q

Since Q is identical here, we can graphically compare P and AC to see if the firm earns short run profits or losses. If P > AC then the firm earns profits and if P < AC then the firm incurs losses.

Here is another way to see this. Profit per unit = revenue per unit (P) - cost per unit (AC). If P > AC then the firm makes a profit on each unit.

In our example, AC = TC/Q = $300,000/50,000 = $6 and P = $8, so the profit per unit is $2 or the vertical distance between points b and a.

Total profit = profit per unit (P-AC) x Quantity. In our example this is $2 x 50,000 = $100,000 or the area labeled $8 $6 a b.

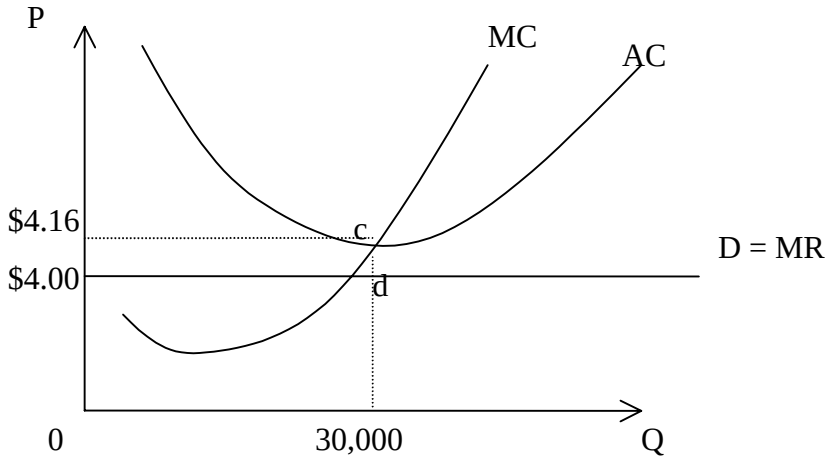
MR = MC gives us the quantity that maximizes a firm's profits but it does not tell us whether the firm is earning profits or incurring a loss. We must compare P and AC to determine this.

Consider the possibility that the perfectly competitive firm incurs losses in the short run. Losses may occur if demand is low or costs are high. In this case, the firm's most profitable option may lead to a loss.

Assume the price of a bushel is $4 and the relevant data is displayed for a farm below.

Quantity (1,000's bushels)	Total Revenue ($1,000's)	Marginal Revenue ($1,000's)	Total Cost ($1,000's)	Marginal Cost ($1,000's)	Total Profit ($1,000's)
0	0	------	45	------	-45
10	40	40	65	20	-25
20	80	40	90	25	-10
30	120	40	125	35	-5
40	160	40	170	45	-10
50	200	40	220	50	-20
60	240	40	275	55	-35
70	280	40	335	60	-55

In this example, the farm's losses are minimized by producing where MR ≥ MC at 30,000 bushels. The total loss is $5,000, which equals the per unit loss (AC - P) of $0.167 x 30,000. These losses are represented in the diagram below.



Since the AC curve lies above the price it is clear that the firm is losing money. The total losses are shown by the area $4 $4.16 c d.

Shutdown and Break Even Decision

Firms can't endure a loss forever. The decision to shutdown involves a comparison between short run (SR) sunk costs and variable costs.

> Sunk costs are costs that cannot be escaped in the SR. For example, a restaurant owner has signed a one-year lease on a building. Sunk costs remain even if the firm's output falls to zero.

If the firm shuts down TR = 0 and TVC = 0, but the TFC (or sunk costs) remain. Sometimes it is better to remain in operation until the sunk costs expire.

There are two rules that govern the shutdown decision. Note: these rules hold for all firms and not just perfectly competitive firms.

Rule 1: if TR > TC then the firm earns positive profits and should remain open in the SR and the LR.

Rule 2: the firm should operate in the SR if TR > TVC, but should plan to close in the LR if TR < TC.

Proof:

Loss if the firm stays in business = TC - TR
Loss if the firm shuts down = TFC = TC - TVC

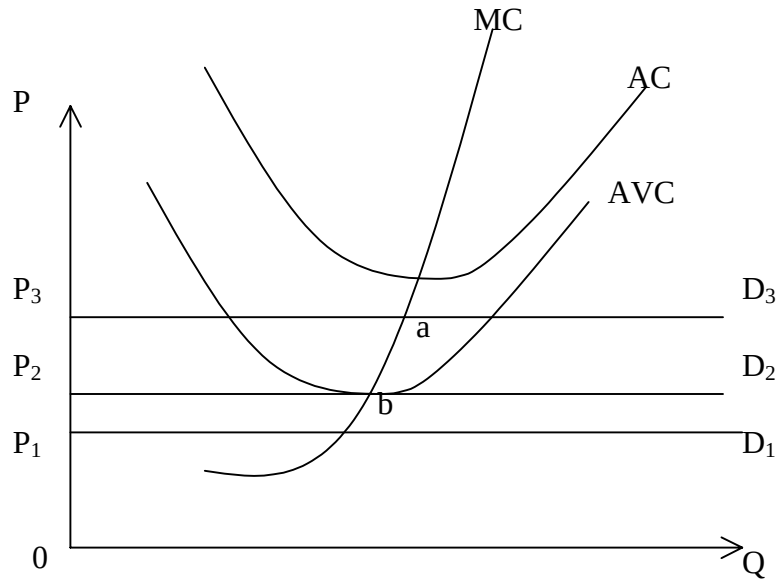
So the firm should keep operating in the SR if:
TC - TR < TC - TVC
or TR > TVC.

Consider the revenue and cost information for two cases.

($1,000's)	Case A	Case B
TR	100	100
TVC	80	130
Sunk Cost	60	60
TC	140	190
Loss if firm closes	60	60
Loss if the firm stays open	40	90

Both cases have the same TR and TFC, but they differ in the amounts of their TVC and hence TC. Both firms should plan to close in the LR because their TC > TR. However, the firm in case A should remain open in the SR. By continuing to operate in the SR, it earns $20,000 in TR above TVC and this money can go toward the fixed cost. The firm in case B should plan to close immediately. By continuing to operate in the short run, it adds $30,000 in TVC above TR. The firm can avoid the $30,000 in variable costs by closing and just losing the TFC.

We can analyze the shutdown decision graphically.



This firm operates at a loss whether the price is P_1, P_2, or P_3. The lowest price to keep the firm operational in the SR is where $P \geq AVC$.

In the SR the firm should stay in business if TR > TVC
or if P x Q > AVC x Q
Since the quantities are equal here P > AVC.

Therefore, the firm will shut down immediately if P < AVC.

At the price of P_1 the firm will shutdown because it cannot cover its TVC.

At the price of P_3 the firm earns revenues above its TVC so it should remain open in the SR and produce at point a where $P_3 = MC$. However, the firm will close in the LR because TR < TC.

At the price of P_2 the firm is indifferent between remaining in business and shutting down since TR just covers TVC. If the firm stays open it will produce at point b where $P_2 = MC$. P_2 is the lowest price at which Q > 0 and it is the minimum point on the AVC curve.

<u>Short Run Supply Curve of the Competitive Firm</u>

We have derived the SR supply curve for the perfectly competitive firm. It is the portion of the MC curve that lies above the minimum point on the AVC curve. Supply tells us how much output is produced at different prices.

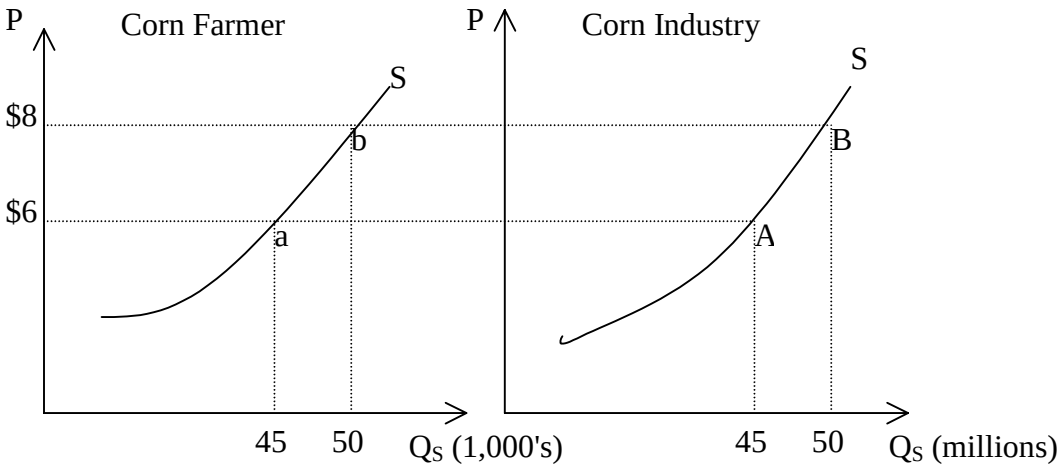
In the SR: (1) If P > AVC then it pays to produce where P = MC. So for any price above point b, MC tells us the quantity supplied.
(2) If P < AVC then quantity supplied falls to zero.

Short Run Supply Curve for the Industry

The SR for the industry is too brief a period of time for new firms to enter or old firms to leave. Thus, the number of firms is fixed in the SR.

The LR for the industry is a long enough period of time for any firm that so chooses to enter or leave the industry. In addition, each firm can adjust its quantity to fit LR costs.

To derive the industry supply curve we simply add up the quantity supplied by each firm in the industry.



For example, if each of 1,000 identical farms in the corn industry supplied 45,000 bushels when the price is $6, then the quantity supplied in the industry is 45,000 x 1,000 or 45 million bushels. Repeating this process for every price and quantity pair derives the industry supply curve.

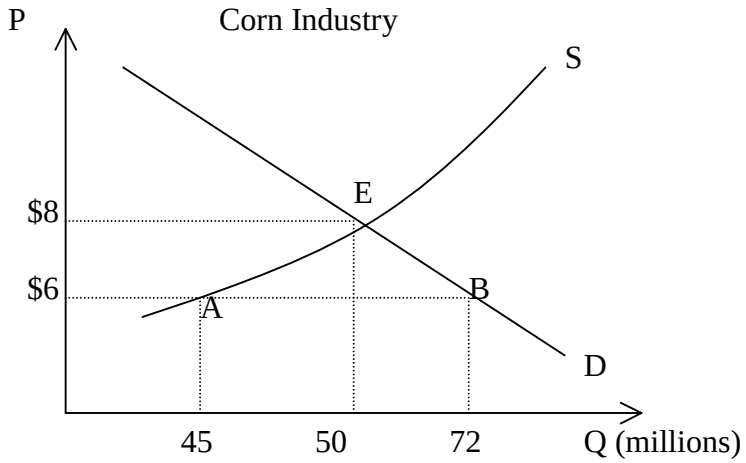
The SR industry supply curve is the horizontal summation of the individual firm's supply curves.

The SR industry supply curve has a positive slope because all of the individual firms have MC curves that slope upward.

The entry of new firms shifts the SR industry supply curve out.

Industry Equilibrium in the Short Run

Industry supply and market demand determine the equilibrium price and quantity.



Individual firms face horizontal market demand curves because they are so small relative to the market. If a firm doubled its output the market price is unchanged. But if every firm in the industry doubled their output, prices would fall to induce consumers to purchase the additional quantity.

The equilibrium occurs at the price of $8 and the quantity of 50 million bushels. Only at the price of $8 do consumers want to purchase the amount the producers want to sell.

If the price were $6 instead, consumers would want to buy 72 million bushels while the producers would like to sell only 45 million bushels. The shortage would end by frustrated buyers offering producers higher prices in order to get the corn they want. The rising prices end the shortage and bring us back to the equilibrium.

Alternatively, if the price were above the equilibrium there is a surplus. The quantity supplied is greater than the quantity demanded, so frustrated sellers would lower their prices to clear out excess inventories. Falling prices bring us back to the equilibrium.

Industry and Firm Equilibrium in the Long Run

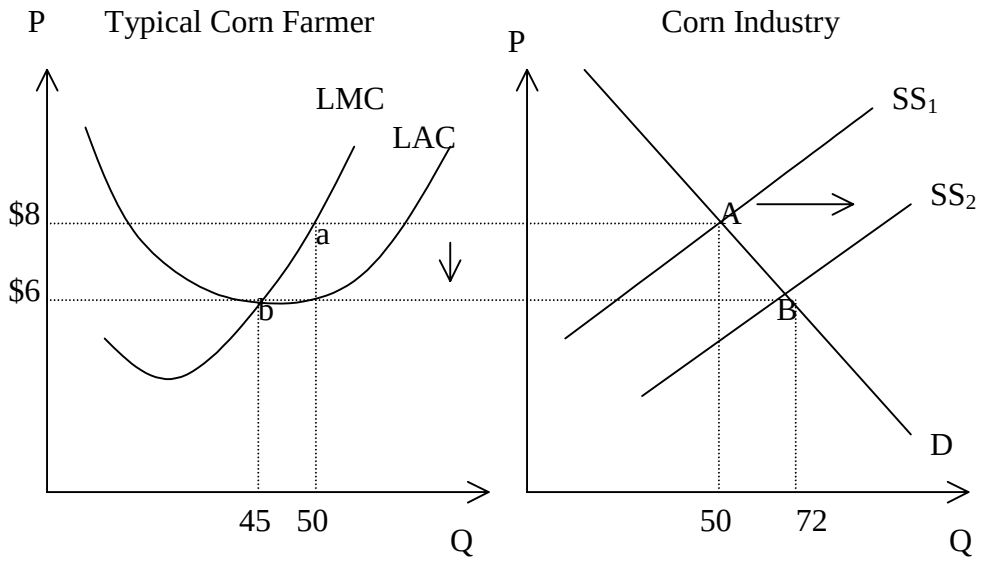
The LR equilibrium may differ from the SR equilibrium because;

(1) the number of firms may differ
(2) firms can vary their plant size in the LR.

Thus, firm and industry cost curves differ in the LR.

Firms enter or exit the industry based on profits earned in the industry. If SR profits are greater than zero, new firms are lured into the industry. Alternatively, SR losses encourage existing firms to exit.

If firms earn high profits in an industry then new firms enter, forcing the market price down as the SR industry supply curve shifts out.



At point a, the typical corn farmer is earning SR profits. This encourages new firms to enter the industry, which shifts the SR Industry supply curve (SS) out thereby reducing the market price. Entry continues until all profits are competed away and we reach the LR equilibrium point b. At this point, the typical firm earns zero profits and produces where LMC = P = LAC.

Note: there are no profits in the LR. If SR profits exist then new firms enter and force the price down until all of the profits are competed away. Alternatively, SR losses encourage existing firms to leave the industry, which force prices up until all losses end. In the LR, competitive firms produce where their LAC = LMC = P.

Zero Economic Profit

Why do firms stay in the industry if profits are zero in the LR? An economist's definition of profit includes the opportunity cost of any capital or labor supplied by the firm's owners. Economists zero economic profit implies positive profit as defined by an accountant.

For example, if investors can earn 15% on their funds elsewhere then a firm must earn a 15% rate of return to cover the opportunity cost of its capital. This 15% is included in the firm's AC curve. If the firm cannot earn at least 15% on the funds invested, then funds will not be given to the firm because investors will go elsewhere. Thus, a firm must earn enough not only to cover labor, fuel, and raw materials --but also opportunity costs of any funds supplied by the owners.

Another example, if U.S. Treasury bills pay 8% and a woman who owns her firm earns 6% on the funds she has invested, an economist would say she is losing 2%. But an accountant would say that the woman earns a 6% rate of return.

Zero economic profit indicates that firms are earning the normal economy-wide rate of profit (in the accounting sense). This is guaranteed by the freedom of entry and exit.

An industry whose capital receives a higher rate of return than capital invested elsewhere attracts capital into the industry. This shifts the SR industry supply curve out and reduces prices until economic profit equals zero.

If capital invested in an industry receives a lower return than capital invested elsewhere, then funds dry up in the industry. This shifts the SR industry supply curve inward, which raises prices until economic profits return to zero.

Long Run Industry Supply Curve

The derivation of the LR industry supply curve (LS) is more complicated than the derivation of the SR industry supply curve (SS). We can no longer sum the individual firms' MC curves because firms are entering or leaving the market. Thus, we don't know which firms' supply curves to sum horizontally. In addition, the prices that firms pay for inputs may change as the industry expands (with entry) or contracts (with exit).

The slope of the LS curve depends on what happens to input prices as the industry expands or contracts. Perfectly competitive industries are classified into 3 industry categories depending on how input prices respond to a change in industry output.

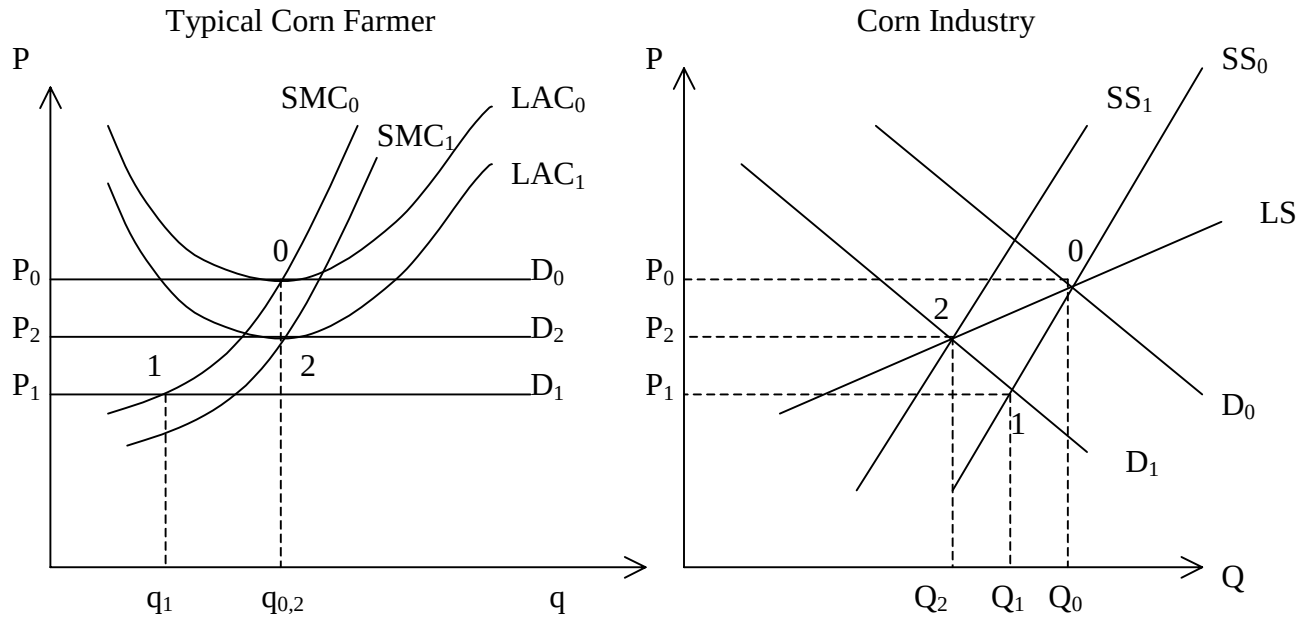
(1) Constant-cost industry: The entry and exit of firms does not affect input prices, so the industry LS curve is horizontal, or perfectly elastic. Input prices are constant because the input supply curves facing the firm are assumed to be horizontal, or perfectly elastic. New firms can enter the industry and produce at the same AC as the existing firms. Thus, the industry can produce more output at a constant cost.

(2) Increasing-cost industry: The entry (exit) of firms raises (lowers) input prices, so the industry LS curve has a positive slope. The expansion of industry output is assumed to bid up input prices because input supply curves have a positive slope. The increasing cost of inputs shifts the firms' cost curves up, so the industry can produce an increased output only if it receives a higher price.

(3) Decreasing-cost industry: This case is purely theoretical and fairly unrealistic. The entry of new firms lowers input prices, so the industry LS curve has a negative slope. This assumes that input supply curves are negatively sloped. It is tough to explain how an increase in the demand for an input (say labor) reduces wages and then leads to an increase in the quantity of labor supplied at lower wages. Enough has been said for you to guess what economists think of downward sloping supply curves.

We will focus our energies on a more realistic case --increasing-cost industries. It is generally accepted that input prices rise as an industry expands (think of software engineers in the Silicon Valley) while input prices fall as an industry contracts (think of textile workers in New England).

We will derive the industry LS curve by considering the diagram below.



Assume an initial LR equilibrium of point 0, where the industry price is P_0 and quantity is Q_0. The typical firm produces q0 units of output and has zero economic profit, as $P_0 = MC_0 = AC_0$. Suppose there is an unexpected fall in the demand for corn (from D_0 to D_1). This reduces the industry price to P_1 and industry output to Q_1. The fall in price causes the typical firm to reduce output to q_1 along its MC_0 curve. Since the price (P_1) falls below AC_0, the firm experiences a SR loss.

The SR losses encourage some firms to leave the industry. The exit of firms is shown by the inward shift of the SR industry supply (from SS_0 to SS_1). This reduction in supply leads to a new equilibrium (point 2) with higher prices (P_2) and lower output (Q_2). This reduction in output lowers input prices, because the demand for the industry's inputs have fallen. Since inputs are assumed to have a positively sloped supply curve, a reduction in input demand lowers their prices. The reduction in input prices shifts the AC and MC curves down to AC_1 and MC_1.

The SR losses are eliminated in 2 ways. First, prices increase from P_1 to P_2 as firms leave the industry. Second, costs fall from AC_0 to AC_1 because input demand falls as industry output falls. Once the losses are eliminated, there is no longer an incentive for industry output to decrease further, and a new LR equilibrium is reached at point 2. Note that every point on the LR industry supply curve (i.e., points 0 and 2) indicate zero economic profit for the typical firm.

Perfect Competition and Economic Efficiency

Perfect competition leads to great efficiency in the LR because firms must produce where price equals the lowest point on their LAC curve. Thus, the output of competitive industries is produced at the lowest possible cost to society. To see this, consider the AC and TC for a perfectly competitive industry.

Firm's Quantity	Firm's AC	Number of firms	Industry Output	Industry TC
60,000	$0.90	200	12,000,000	$10,800,000
100,000	0.70	120	12,000,000	8,400,000
120,000	0.80	100	12,000,000	9,600,000

Suppose the industry produces 12 million bushels of corn a year. This is accomplished by 120 firms producing 100,000 bushels of corn a year. Suppose the lowest point on the AC curve corresponds to the output of 100,000 bushels with an AC of $0.70 per bushel. The lowest cost way to produce 12 million bushels in the industry is to have 120 farms producing 100,000 bushels each.

Total industry cost = AC x industry output, so the total industry cost is lowest by having each firm produce at the lowest AC possible.

Even though each farmer is concerned with her own profits, the corn industry is guided by producer costs and consumer demands to produce the amount that society wants at the lowest possible cost.