I. **Short-Run Conditions**

We are going to transition from looking at decisions made by firms in the short-run to decisions made in the long-run. But in a sense these decisions are interrelated. What happens in the short-run is going to affect the long-term decisions. For example, if your firm is currently incurring a loss, you have to think both in the short-run (how to minimize the losses for your firm) and in the long-run (should you shut down your business).

At any given moment, a firm is either earning a profit, incurring a loss, or breaking even. As we saw in Chapter 7 we say that a firm is earning an *economic profit* if the rate of return is above the normal rate of return. The normal rate of return is the rate which keeps investors happy to stay in the industry. If the investor could get a 10% return in an alternative investment with the same level of risk, then 10% is the normal rate of return. Firms are earning an *economic loss* if the rate of return is below the normal rate of return. Finally firms are *breaking even* if the rate of return is exactly equal to the normal rate of return.

Firms that are making a profit will want to maximize profits in the short-run, while those that are making a loss will want to minimize the loss. We’ll look in turn at each of the short-run situations in which firms may find themselves in.

**A. Economic Profit**

*Figure 1* shows a situation where a firm in a perfectly competitive industry is earning an economic profit.

*Figure 1: Firm earning an economic profit in the short-run*
Determining the economic profit among all the curves maybe a little confusing, so we’ll take it one step at a time.

Step #1: **Find the equilibrium price.** Equilibrium price is determined by market demand and market supply curves (Panel A). Where they intersect is the equilibrium price for the good. In this case, the price will be $5.

Step #2: **Draw now the cost curves and marginal revenue curve for the individual firm.** Because the firm is perfectly competitive the marginal revenue curve is equal to the demand curve which itself is equal to the equilibrium price. We draw three of our cost curves: (1) marginal cost curve, (2) the average total cost curve, and (3) the average variable cost curve. We derived how to draw these curves in Chapter 8.

Step #3: **Find the profit-maximizing output.** Recall from Chapter 8 that a firm will produce up until MR=MC. We can see in Figure 1 that occurs at Point A. At Point A, the MR = MC and the associated output level is q* = 300.

Step #4: **Calculate total revenue.** Total revenue is P x Q. We know that the firm will supply 300 units of output and we know that the price of each unit of output is $5. Thus the total revenue is equal to $1500. Graphically, it is the rectangle p*0Aq* (the shaded blue/gray area) in Figure 1.

Step #5: **Calculate total costs.** Although we haven’t drawn the total cost curve we can easily derive the total costs from the ATC curve. ATC = TC/Q which we can rearrange to ATC x Q = TC. We already know that quantity is 300, we just need to figure out ATC. To figure out ATC we look at the graph and see what is the average total cost when output is equal to 300. We see that when output is equal to 300, ATC = 4.20 (Point B in Figure 1b). Thus total costs are equal to $4.20 x 300 = $1260. Graphically this is the area represented by the blue shaded rectangle in Figure 1.

Step #6: **Calculate profits.** Profits are equal to total revenue – total costs. Since total revenue is equal to $1500 and total costs are $1260, profits are equal to $240. Graphically this is the gray rectangle.

Firms that are earning profits will stay in the industry and will expand their operations in the long-run. Additionally, firms outside the industry will be attracted to the above normal profits and will enter the industry in the long-run.

**B. Economic Losses**

What if the firm is suffering negative profits? In the short-run firms that are incurring losses can either:

1. Keep producing in order to try to minimize those losses.
2. Shut down immediately
One might wonder why a firm would want to continue to produce if it was experiencing losses. The simple answer is that it might suffer even greater losses by shutting down than if they continued to produce output.

If a firm does not produce any output it will suffer a loss equal to its fixed cost. This is the maximum loss a firm is willing to accept. If by producing a firm loses an amount greater than its fixed costs, the firm will shut down.

If total revenue is greater than total variable cost it can use some of the extra money to cover some of its fixed costs. In such cases, the firm will continue to produce even though it is suffering losses. By the same token if the total revenue is less than the total variable cost, the firm will not have anything left over to cover its fixed costs. Indeed, it won’t have enough to cover all of its variable costs. So the firm’s loss will be fixed costs + some variable cost. The firm at that point will simply shut down.

**The shut-down rule** is that the firm should shut down if total revenue < total variable cost

Since \( TR = P \times Q \)

We have \( P \times Q < TVC \rightarrow P < TVC/Q \rightarrow P < AVC \)

If the price drops below the AVC, the firm will have a smaller loss if it shuts down completely and produces no output.

To summarize if the firm is experiencing losses and

- If \( P > AVC \) then the firm should continue to operate
- If \( P < AVC \) then the firm should shut down immediately.

Figure 2 is a graphical representation of a case where the firm is experiencing a loss, but will still produce.

**Figure 2: Firm with an Economic Loss**
Again we can follow the steps we did when we looked at the case of a firm that was experiencing profits.

Step #1: Find the equilibrium price. In this case it is $3.50 in Figure 2
Step #2: Draw the cost curves and the MR curve.
Step #3: Identify the optimal production point for the firm. The firm will always produce where MR=MC even if it is experiencing losses. In this case the marginal cost curve intersects the marginal revenue curve at Point A where quantity is equal to 225.
Step #4: Calculate total revenue: $787.50 = P x Q = $3.50 x 225
Step #5: Calculate total costs: $922.50 = ATC x Q = $4.10 x 225
Step #6: Calculate the profit: In this case the profit is negative.

Profit = $787.50 - $922.50 = -$135. The loss is the red rectangle in Figure 2.
Step #7: Since the firm is experiencing an economic loss the firm has to decide whether to shut down immediately or continue producing in the short-run. We look at where is the AVC at q=225. This is Point E. When q=225, AVC = $3.10. Since P > AVC ($3.50 > $3.10) the firm should continue producing. Why? Total variable costs are ($3.10 x 225 = $697.50) while total revenue is $787.50. The firm has enough to cover its variable costs and will have extra funds ($90) to use to pay down some of their fixed costs. If the firm had simply shut down operations it would have been stuck paying the entire fixed costs of $225 and thus its losses would have been greater.

As we discussed earlier, if the price of the output continued to fall to the point where P < AVC the same firm will find it advantageous to shut down. The minimum point of the average variable cost curve is called the shut-down point. If the price falls below this level the firm will save money by shutting down immediately. Figure 3 illustrates this general case.

Figure 3

In the long-run, however all firms that are experiencing a loss will leave the industry.
II. Long Run Costs

One of our assumptions of the short-run was that firms had some fixed-factor of production which prevented firms from expanding beyond a certain point. The “U-shape” of the cost curves reflects the fact that as the firm gets closer to its constraint, its cost will steadily increase. In the long-run, firms have no fixed factor of production. Firms are free to choose any level of production (scale of production) they wish. They can choose to be small firms and produce a limited quantity or they could choose to be large firms and produce an enormous amount of output. In this section, we will look at how firms make the decision regarding its size.

Unlike the short-run cost curves, the shape of the long-run cost curve depends on the assumptions we make concerning increased production and the long-run average costs. These assumptions are:

1. **Increasing Returns to Scale (Economies of Scale):** An increase in production will lower average costs.
2. **Constant Returns to Scale:** An increase in production will have no effect on average costs.
3. **Decreasing Returns to Scale (Diseconomies of Scale):** An increase in production will increase average costs.

A. Increasing Returns to Scale

When a firm is experiencing increasing returns to scale this means that if a firm were to double the amount of inputs used to produce output, the amount of output would more than double. The following example shows how firm’s with increasing returns to scale will see lower average costs as output increases.

Example: Suppose that a firm produces widgets using only capital and labor as inputs. In order to produce 100 widgets, the firm uses 4 units of capital (K) and 10 units of labor (L).

Assume the following

Price per unit of capital is $2
Price per unit of labor is $1

Calculate the average total cost for this firm.

\[
ATC = \frac{TC}{Q}
\]

We know that \(Q = 100\)

Total costs are just going to be the cost of capital (the price of capital x the number of units of capital used) plus the cost of labor (the price of labor x the number of labor units).

\[
TC = (4 \times \$2) + (10 \times \$1) = $18
\]

Thus \(ATC = \frac{18}{100} = \$0.18\).

Now suppose the firm doubles the amount of capital and labor. The firm now uses 8 units of capital and 20 units of labor. If the firm has increasing returns to scale, the number of widgets produced must be greater than 200. Suppose the number of widgets produced when K=8 and L=20 is 250 widgets.
Let us now calculate the ATC for the firm, assuming input prices stayed constant.
Total cost = (8 x $2) + (20 x $1) = $36

Thus ATC = $36/250 = 0.144

Note that as we increased production from 100 to 250, average total costs have fallen from 0.18 to 0.144.

Two sources of increasing returns to scale are
1. **The adoption of technology that favors large scale production** (ex. Standardized production in the auto industry)
2. **Bargaining power resulting from size** (ex. Walmart)

**Graphical Representation of Increasing Returns to Scale (Economies of Scale)**

The long-run average cost curve shows the scale of production a firm can choose to operate in the long-run and the average cost associated with production at a given level of output.

**When the firm experiences economies of scale, the LRAC will decline with output.**

Once a firm chooses a scale of production, it is “locked-in” its choice in the short-run and will face the short-run cost curves associated with that scale of production. Figure 4 shows a hypothetical long-run average cost curve.

**Figure 4**

You should notice several things from Figure 4
- The firm will experience economies of scale up to the production of 100,000 units of output. This is because as we increase production, the average cost per unit is declining (the LRAC is declining).
• The point at which the LRAC is at its minimum is called the **minimum efficient scale (MES)**. The MES tells us the optimal size the firm should choose to operate to get the lowest average cost. Firms in order to be competitive must reach at least the MES. For example suppose a firm had to decide between producing at Scale 1 (50,000 units) or Scale 2 (100,000 units). If the firm chose Scale 1, it would face higher average costs than a larger firm who chose Scale 2. The firm at Scale 1 would be at a serious disadvantage. Firms should thus reach at least MES. If MES is very large for an industry only a few firms will be able to successfully compete in the industry.

**B. Constant Returns to Scale**

When a firm is experiencing **constant returns to scale** this means that if a firm were to double the amount of inputs the amount of output would double.

Example: Suppose that a firm produces widgets using only capital and labor as inputs. In order to produce 100 widgets, the firm uses 4 units of capital (K) and 10 units of labor (L).

Assume the following:
Price per unit of capital is $2
Price per unit of labor is $1

As we saw earlier the ATC = $18/100 = $0.18.

Now suppose the firm doubles the amount of capital and labor. The firm now uses 8 units of capital and 20 units of labor. If the firm has constant returns to scale, the number of widgets produced must be 200.

Let us now calculate the ATC for the firm, assuming input prices stayed constant.

Total cost = (8 x $2) + (20 x $1) = $36
Thus ATC = $36/200 = 0.18

Note that as we increased production from 100 to 200, average total costs have remained constant at 0.18.

**Graphical Representation of Constant Returns to Scale**

If a firm is experiencing constant returns to scale the average cost will be constant as production increases. Graphically this means that the LRAC will be flat when the firm has constant returns to scale. Referring to Figure 4, we see that between Scales 2 and Scale 3 the curve is relatively flat which suggests that between the production of 100,000 and 150,000 units, the average cost is the same.

**C. Decreasing Returns to Scale (Diseconomies of Scale)**

When a firm is experiencing **decreasing returns to scale** this means that if a firm were to double the amount of inputs the amount of output would be less than doubled. The average cost will increase as production increases as is evidenced by the following example.
Example: Suppose that a firm produces widgets using only capital and labor as inputs. In order to produce 100 widgets, the firm uses 4 units of capital (K) and 10 units of labor (L).
Assume the following
Price per unit of capital is $2
Price per unit of labor is $1

As we saw earlier the ATC = $18/100 = $0.18.

Now suppose the firm doubles the amount of capital and labor. The firm now uses 8 units of capital and 20 units of labor. If the firm has decreasing returns to scale, the number of widgets produced must be less than 200. Suppose that 8 units of capital and 20 units of labor will produce 150 units of output.
Let us now calculate the ATC for the firm, assuming input prices stayed constant.
Total cost = (8 x $2) + (20 x $1) = $36
Thus ATC = $36/150 = 0.24

Note that as we increased production from 100 to 150, average total costs have increased from 0.18 to 0.24.

Two sources of decreasing returns to scale are
(1) Increased bureaucracy as size increases leads to inefficiency
(2) Presence of organized labor that would drive up wages

Graphical Representation of Decreasing Returns to Scale
If a firm is experiencing decreasing returns to scale the average cost will increase as production increases. Graphically this means that the LRAC will be increasing. Figure 5, we see that beyond the production level q*, the LRAC starts increasing. As production increases beyond q*, the average costs increase.

Figure 5
III. Long Run Adjustments to Short-Run Conditions

**Long-run equilibrium** is a point where firms have no incentive to either enter or exit an industry. We have seen that when there are economic profits firms will want to enter an industry, and likewise when there are economic losses firms will want to leave an industry. We’ll take a closer look at these two non-equilibrium scenarios.

### A. Economic Profits in the Short-Run

Figure 6 shows an industry that is experiencing economic profits in the short run. At the current price $P_1$ the firm will choose production at $q^*$ (since Point A is where $MR=MC$). The total revenue is the rectangle $PAq^*0$ while the total cost is the rectangle $TCBq^*0$. This leaves profit to be the shaded rectangle $(PABTC)$. Thus at $P_1$ the individual firm would be experiencing profits since $P > ATC$ where $MR=MC$. If this occurs two things will happen:

- Other entrepreneurs will see that the individual firm is making above-normal profits and will want to get into the industry. This will shift the market supply curve to the right.
- Existing firms who are experiencing profits will want to expand their operations *as long as they are experiencing increasing or constant returns to scale*. If the firm had diseconomies to scale they would not want to expand, since increasing production would increase average costs and lower profits. As long as there are no diseconomies to scale, existing firms will expand. This will have the effect of shifting the supply curve to the right.

**Figure 6**
Figure 7 shows what the end result will be. As existing firms expand, and new firms enter the industry, the market supply curve will shift to the right. As the supply curve shifts, the equilibrium market price will decline. The supply curve will continue to shift until **there are no more profits in the industry.** That point is where \( P = MR = MC = ATC \). At this point \((q^{**})\) the total revenue is exactly equal to total costs. Individual firms are earning zero economic profits and thus there will be no incentive to either leave or enter the industry and thus the firm is in long-run equilibrium.

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**Figure 7**

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For completeness, the point of long-run equilibrium also has to be the minimum point on the long-run average cost curve. This is true, because if the firm had increasing returns to scale the firm could achieve lower costs by expanding and thus have higher profits. Thus the long-run equilibrium condition is \( P = MR = MC = ATC = LRAC \). (See page 191 in your text for a complete discussion on this point).

### B. Economic Losses in the Short-Run

Figure 8 shows an industry that is experiencing economic losses. As before the market price is determined by the industry. In this case the price if \( P_1 \). At that price the firm will produce at Point A where \( MR = MC \). At that point, total revenue is the rectangle \( PAq^*0 \) while total costs will be the larger rectangle \( TCBq^*0 \). The representative firm will be experiencing an economic loss (the red shaded rectangle \( TCBAP \)). We know that in the long-run firms are free to leave the industry. If firms are experiencing economic losses they will leave the industry. Figure 9 shows what will happen as firms start leaving. The supply curve shifts to the left and the equilibrium market price starts to increase. Firms will stop leaving once economic losses are eliminated. At the price \( P_2 \) the firm will produce where the new \( MR \) curve intersects the \( MC \) curve at \( q^{**} \). At this point total revenue is equal to total costs and the firm will now be earning zero economic profits. As with the short-run profit case, long-run equilibrium will be where \( P=MC=MR=ATC=LRAC \).