

- I. Profit maximization
- II. Perfect competition
 - A. Output decision of firm
 1. Short run
 2. Long run
 - B. Long-run equilibrium: the role of entry and exit
 - C. Strategic implications

I. Profit maximization

Goal of firm is to set production level (q) so that it maximizes profits (Π), where

$$\Pi(q) = TR - TC = p(q)q - C(q),$$

and $p(q)$ indicates price that can be charged at each production level, with $dp/dq < 0$, and $dC/dq > 0$ for all q beyond a given threshold (rising MC). Before looking at graphs and algebra, think about underlying situation in common sense terms:

1. As firm expands output, revenue increases as more units are sold.
2. As firm expands output, price per unit has to be cut to generate additional sales, which hurts revenue. Suppose you could sell 20 glasses of lemonade at 50 cents per glass, but sales increase to 24 glasses at 40 cents per glass. By selling 4 more glasses, you add \$1.60 ($=4 \cdot .40$) in revenue with new business coming in, but lose \$2 ($=20 \cdot .10$) in revenue from your old customers. In this case TR actually drops. If demand had increased to 25 (26 or more) glasses, TR would have stayed the same (increased). Once again, elasticity of demand matters!
3. As firm expands output, costs increase at an increasing rate.

Points 1 and 2 mean that TR increases with output, but at a decreasing rate. Define *marginal revenue* (MR) as the change in TR that results from a change in output. The trick to maximizing profits is to increase output as long as MR is greater than or equal to MC.

Theory: frictionless, all-knowing firm continues knows $p(q)$, $C(q)$ and picks q where $MR=MC$. (If produces less than optimal q , then $MR > MC$ and can increase Π by producing more; if produces more than optimal q , then $MC > MR$ and can increase Π by producing less.)

Proof: Maximize Π when

$$d\Pi/dq = 0 = q(dp/dq) + p(q) - dC/dq$$

Note that $p(q)$ is revenue gained from selling one more unit and $q(dp/dq) < 0$ is revenue lost from having to cut price to generate extra unit of sales, so the first two terms are $MR(q)$. The last term is $MC(q)$. For optimal output q^* , $MR(q)-MC(q) = 0$, or

$$\text{MR}(q) = \text{MC}(q)$$

Aside: other formal conditions that must hold are (1) $d^2\Pi/dq^2 < 0$ (profit function must be concave; if convex, you would be minimizing profits) and (2) $\Pi(q^*) > \Pi(0)$ (always check corner solutions, in some cases you could lose less money by not producing at all than by producing).

Practice: Firms have fixed capacity (remember we are talking short run here) and can change output by (1) changing hours of operation by staying open later or earlier, adding an extra shift, (2) hiring more workers if below capacity, and/or (3) working overtime. If they are near capacity, they have to decide which orders to take and which ones to reject. The rule of thumb they will use is whether extra revenue offsets extra cost.

Often tempting to use AVC as estimate of MC. (Why isn't ATC tempting?) Text has good example on pp. 261-263 where this will get you in trouble. If extra output requires a shift from straight time to overtime, then MC estimate must take this into account. Otherwise you will underestimate cost and overestimate profit.

This is a general rule, and applies in a wide range of cases. One of them is case where firm has no control over price, which we will do in great detail in a minute. Others that are relevant:

- (1) Constant marginal cost goods (e.g., where there is so much excess capacity that law of diminishing returns never comes into play, maybe steel today?). This just means MC is a constant and continue to produce until $\text{MR}=\text{MC}$.
- (2) Zero marginal cost goods (e.g., shrink-wrapped software). Produce until $\text{MR}=0$.

II. Perfect competition

Will now start examining output and pricing decisions under varying assumptions about market conditions. Book starts with perfect competition, so we will too. Key assumptions: (1) large number of firms so that no one can influence price, (2) all produce identical product so no brand loyalty, (3) easy entry and exit, and (4) well-informed buyers and sellers so that no one can fool someone into paying too much or accepting too little. Will later study monopoly, where there is one firm and entry is difficult, and oligopoly, where there are a few firms, entry is difficult, and brand loyalty is a factor.

A, Output decision of firm

1. Short run

Firm takes price as given, at $p=40$. Note that $P=\text{MR}$. Can sell as many units as it wants at that price. Cost curves we know about already.

Reading the diagram (slide 6, same as Figure 8.3):

$$\text{TR} = P \cdot Q$$

$$\text{TC} = \text{ATC} \cdot Q$$

$$\text{VC} = \text{AVC} \cdot Q$$

$$\Pi = \text{TR} - \text{TC} = (P - \text{ATC}) \cdot Q$$

$$\text{FC} = (\text{ATC} - \text{AVC}) \cdot Q$$

What will output be?

1 = q_0 ? $P=MC$ but $P>MC$ for $q > q_0$, so clearly can add profits by producing more.

7 = q_1 ? At q_1 and any point to left of q^* and right of 1, still have $P>MC$, so this will not work.

9 = q_2 ? At q_2 and any point to right of q^* , have $P<MC$, so can raise profits by producing less.

8 = q^* ? At this point $P=MC$ and profits are maximized.

What if $ATC > P > AVC$?

This is depicted in next Figure (slide 7, same as 8.4 in text). Here $\Pi < 0$, but still makes sense for the firm to produce because losses would be even bigger if $q=0$. If $q=0$, firm would still be stuck with fixed costs of $CBEF >$ losses of $AEFD$ if firm produces q^* . This may sound funny, but keep in mind this is short run and firm cannot change K or other fixed inputs. Naturally, if it expects $p < AT$, the firm will have to think about bailing out, but if firm expects p to rise in future, it makes sense to stick it out.

What if $P=ATC$?

This is classic case where firm has zero economic profits, but has accounting profits that are equal to best alternative return on capital.

What if $AVC > P$?

This figure (not in text) shows losses of $ABCD$ which are greater than fixed costs of $AEFD$ at output level where $P=MC$. Firm is better off producing zero.

Lesson:

MC curve above AVC is supply curve of firm. Firm produces at output level where $P=MC$ as long as $P > AVC$. If $P < AVC$, then $q=0$.

Sample exercise (#4, parts a & b, p. 296).

3. Suppose you are the manager of a watchmaking firm operating in a competitive market. Your cost of production is given by $C = 200 + 2Q^2$, where Q is the level of output and C is total cost. (The marginal cost of production is $4Q$. The fixed cost of production is \$200.)

- a. **If the price of watches is \$100, how many watches should you produce to maximize profit?**
- b. **What will the profit level be?**

What about supply curve of industry? Easy answer in short run is just take supply curve of each firm and add them all up horizontally. Get additional output when p increases because (1) each firm produces more and (2) more firms enter the market. (More complicated answer: as each firm produces more and more firms enter, labor and material prices might be bid up and actual increase in output would be less than that implied by adding up each firm's supply curve.)

2. Long run

Firm can adjust K in long run and select different set of SR cost curves. Smart managers will aim for lowest ATC in long run, as long as they think they can sell the goods. (Which always is the case in perfect competition!) Thus in long run we expect

$$P = \min LAC$$

where LAC is long run average cost. This is a nice property, it means that perfect competition results in the most efficient production.

A. Long-run equilibrium: the role of entry and exit

In short run, the number of firms and certain inputs for each firm are fixed. We can say firms and market are in equilibrium when

Firm:	$P=MC$
Industry:	$Q_D=Q_S$

In long run, firms can adjust K and other fixed inputs. This means they can enter new markets or leave existing markets. Equilibrium means balance or no further tendency to change, so what conditions must hold for the market and each firm in the market to have the optimal output? And for no one to want to reallocate their assets? And what will price be at that output?

We must add a rule that accurately portrays the entry and exit decisions of firms:

$$\begin{aligned} &\text{Enter if } E(\Pi) > 0 \\ &\text{Exit if } E(\Pi) < 0 \end{aligned}$$

If $\Pi > 0$, then firms are earning more than their opportunity cost of capital. If $E(\Pi) > 0$, then this situation is expected to persist. In an environment of easy entry, other firms will move into this market (and existing firms will expand) as long as they expect this situation to continue long enough for them to also generate $\Pi > 0$. I emphasize $E(\Pi)$ rather than Π , because entry is much less likely to take place if $\Pi > 0$ simply because of very short-term increases in product prices or decreases in input prices. (Recall under competitive supply that $\Pi < 0$ need not imply immediate exit. If owners anticipate better conditions in the near future they will endure short-term losses.) Entry will continue when $E(\Pi) > 0$ until so many firms have entered that the extra production (and lower prices) brings us back to a situation where $E(\Pi) = 0$. Technically, S shifts right as firms enter until $\Pi = 0$.

When $\Pi < 0$, the opposite chain of events takes place. If this situation is expected to persist, some firms leave and others scale back their operations. S shifts gradually left and prices rise until $\Pi = 0$.

Once $\Pi = 0$, there will be no further tendency for firms to leave or enter, making this a long-run equilibrium condition for an industry. A more complete description of long run equilibrium for an industry is

Firms maximize profits: $P = MC = \min LAC$
All goods produced are sold: $Q_D = Q_S$
No one wants to enter or leave: $\Pi = 0$

Case study:

Robert Goizueta used the concept of economic profit to restructure Coca-Cola in the 1980s. Goizueta calculated that the opportunity cost of capital for Coke's shareholders was 16 percent. Then he calculated returns for different product lines of Coke. The result? Outside of soft drinks and beverages, Coke's business lines were only earning 8 to 10 percent (Coke was into aquaculture and industrial water treatment at the time). This meant Coke's shareholders would be better off if they put their money elsewhere instead of most of Coke's product lines.

Business decisions: (1) Goizueta sold off all product lines that made less than 16 percent. (2) Goizueta installed an accounting system that would measure economic profit, a system today known as Economic Value Added or EVA. EVA was developed by Stern Stewart & Co. (<http://www.sternstewart.com>) and equals

$$\text{EVA} = \text{OPBT} - \text{TAX} - (\text{TCE} \times \text{COC})$$

where

OPBT = operating profits before taxes = sales – wages – materials – depreciation

TAX = federal, state and county taxes

TCE = total capital employed

COC = cost of capital

When $\text{EVA} > 0$, the firm “creates value” in Stern Stewart lingo, that is, it earns more than its stockholders could have gotten elsewhere. When $\text{EVA} < 0$, you get the picture. A full-blown EVA model requires 164 adjustments to income statements; in practice it is done with 5 to 15 adjustments. What is striking is that the EVA concept is equivalent to our “Enter if $E(\Pi) > 0$, Exit if $E(\Pi) < 0$ ” rule.

The reading “Beyond Performance Measurement: The Use and Misuse of Economic Profit” shows how EVA calculations can be used to make strategic decisions. Exhibit 1 shows how you can use it (like Goizueta) to evaluate different business units within a company (in this case a specialty chemicals company). Exhibit 4 breaks this down even further *by customer*, so that you can tell which accounts are profitable (in EVA terms) and which customers you might want to lose. Concept can be applied for entire firms (exhibit 2) or industries (exhibit 3). Article flags a key pitfall in using EVA as well: just because it is high (low) now, don't presume it will be high (low) forever. You may end up expanding (exiting) at a very inopportune moment.

Response to demand changes:

Three possible cases discussed in text: constant, increasing and decreasing costs. This is unnecessarily complicated; will focus on constant cost case. Here are the essentials:

1. Increase in market demand:
 - If market D increases, get increase in P and Q as each firm produces more along the original short run supply curve.
 - In long run firms enter, moving S to right.

- Entry will continue until $\Pi=0$. In constant cost industry, this means we return to original price. (Example: strip shopping centers in RTP)

Response to demand increase	Short run	Long run
Change in price	+	0
Change in industry output	+	++
Change in # firms	0	+
Change in each firm's output	+	0
Level of economic profits for each firm	>0	0

2. Decrease in market demand is the exact opposite of the situation above:
- If market D decreases, get decrease in P and Q as each firm produces less along the original short run supply curve.
 - In long run firms exit, moving S to left.
 - Exit will continue until $\Pi=0$. In constant cost industry, this means we return to original price.

Response to demand decrease	Short run	Long run
Change in price	-	0
Change in industry output	-	--
Change in # firms	0	-
Change in each firm's output	-	0
Level of economic profits for each firm	<0	0

3. The book does not go into what happens when there is a change in costs or technology. Suppose the price of labor went up. Then we would expect the following to happen:

- ATC shifts up by the following percentage: % change in price of labor * ratio of labor to total cost
- MC (AVC) shift as well; extent of shift depends on ratio of labor MC to total MC (ratio of labor VC to total VC)
- S curve shifts left by the same percentage as MC curve

The net result in the short run would be higher price and lower industry output, using the basics of supply and demand. It is messy to say exactly what happens to the firm's cost curves, because each may shift upward by a slightly different percentage. To make things simple, assume that all shift by the same amount. We do know for sure that in the aggregate that all firms must be producing less. Since the number of firms is fixed in the short run, this necessarily implies that each firm is producing less. Finally, what happens to profits? We know that the price increase will be less than the cost increase, as long as the demand curve is not vertical. This means profits will become negative.

In the long run, firms will leave until the percent change in price is the same as the percent change in cost. This will push prices even higher and reduce industry output even more. The percent change in price must end up equaling the percent change in costs (otherwise profits do not return to zero). Assuming there is no change in the slope of the cost curves, this means that output for each firm returns to its original level. The following table summarizes the results:

Response to cost increase	Short run	Long run
Change in price	+	++
Change in industry output	-	--
Change in # firms	0	-
Change in each firm's output	-	0
Level of economic profits for each firm	<0	0

B. Strategic implications

With all of this emphasis on zero economic profits, it is easy to lose sight of the fact that some firms persistently report higher accounting profits than others. Even if the numbers are filtered through an EVA model, you would find in practice the same patterns for economic profits – and often cost management is the reason.

How can firms sustain obtain a cost advantage? This is a two part question. The first part is how can they create a cost advantage in the first place; the second part is how can they keep it. Here is what we have learned:

1. Create cost advantage by

- Right decision on size
- Right decision on scope (keep in mind there can be diseconomies here too if you have too many product lines and you lose efficiency switching production from one to the other or building up too much overhead to keep track of the different products)
- Get an early start and ride down the learning curve
- Make your ATC lower by paying less for labor (on a productivity-adjusted basis) by avoiding unions, examining staffing requirements, and creating the right incentives
- Make your ATC lower by searching out and negotiating the best deals for materials and energy possible
- Make your ATC lower through better management, which includes the right organizational structure, the right “make-buy” decisions, and the right incentives.
- Investing in process R& D

2. Sustain cost advantage by making it hard to copy by other firms

- Don't stop learning. Early entrants get a sustained, permanent advantage from learning curve effects.
- Invest in patents, trademarks, etc. to protect others from copying proprietary secrets that create cost advantages in production.
- Treat key managers, suppliers, employees well so that you can have a long term relationship
- Write long term contracts as needed to legally lock-in valuable resources

Note that economies of scale and scope are hard to protect as a general rule (unless the econ of scale are so big that you can control the whole market).

Reader's guide to chs. 7&8:

Skip the following:

“Inflexibility of SR production,” 234-235

“Producer Surplus in SR,” 279-281

“Economic Rent” and “Producer Surplus in Long Run,” 286-287

“Increasing-Cost Industry” and “Decreasing-Cost Industry,” pp. 289-291

