L10 – Theory of the Firm: Firms in Competitive Markets

Given the cost function and the demand function, the optimal quantity q depends on the market structure:

- ❖ Perfectly competitive market
- ❖ Monopoly market
- ❖ Duopoly or Oligopoly market

We begin by studying the behavior of firms in perfectly competitive markets.

I. What is Competitive Market (Perfect Competition)?

- ❖ There are some characteristics of a competitive market (sometimes called a perfectly competitive market).

  1) Consumers believe that all firms in the market sell identical products.
  2) Buyers and sellers know the prices charged by firms.
  3) Firms can freely enter or exit the market in the long run.

4) Transaction costs – the expenses of finding a trading partner and making a trade for a good or service other than the price paid for that good or service – are low.

- ❖ Each buyer and seller is a "**price taker**" (i.e. takes the price as given).
  - The demand curve faced by each firm is horizontal (perfectly elastic). (not the market demand)
    - At the market price the firm can sell as much as it likes, so the firm has no incentive to lower the price.
    - In the long-run the profit of all firms is 0. So even if one firm dropped its price, all other firms would follow. At the new price all firms would have a negative profit. So no firms would drop its price.
    - If the firm increases the price, its sales drops to 0.

Example of Price Taking:
Let's assume that you own 1000 shares of Best Buy Company (an electronic retailer). Its total shares outstanding is 381 million.
The questions are:
Are you willing to sell your share below the market price ($20.17)?
Will you be able to sell your shares above the market price ($20.17)?

Do you think the sale of your share would have any impact on the company's stock price in the market?

❖ "Firms can freely enter or exit the market" means there are no barriers or impediments to entry or exit.

Example: the government does not restrict the number of firms in the market.

- o A competitive firm can keep increasing its output without affecting the market price. So, each one-unit increase in Q causes revenue to rise by P (i.e., MR = P).

Note: These revenue concepts are analogous to the cost concepts (TC, ATC, MC).

II. The Revenue of a Competitive Firm

Definitions:

$$Total\ Revenue: TR = P \times Q$$

$$Average\ Revenue: AR = \frac{TR}{Q} = P$$

$$Marginal\ Revenue: MR = \frac{\Delta TR}{\Delta Q}$$

❖ The demand curve perceived by an individual firm is perfectly horizontal at P = MR = AR.

❖ By definition, average revenue is always equal to price.

❖ But marginal revenue is equal to price only for firms who operate in competitive markets.

III. Profit Maximization

What Q maximizes the firm's profit?

Two-Steps Decision:

1. Output decision: If the firm produces, what output level, q, maximizes its profit or minimizes its loss?

2. Shutdown decision: Is it more profitable to produce q or to shut down and produce no output?

1) Output Rules:

Recall:
- The MC curve is upward sloping.

❖ MR and AR can be shown by a horizontal line at the market price.

❖ If increase Q by one unit, revenue rises by MR, cost rises by MC.

❖ At the profit-maximizing level of output, MR = MC.
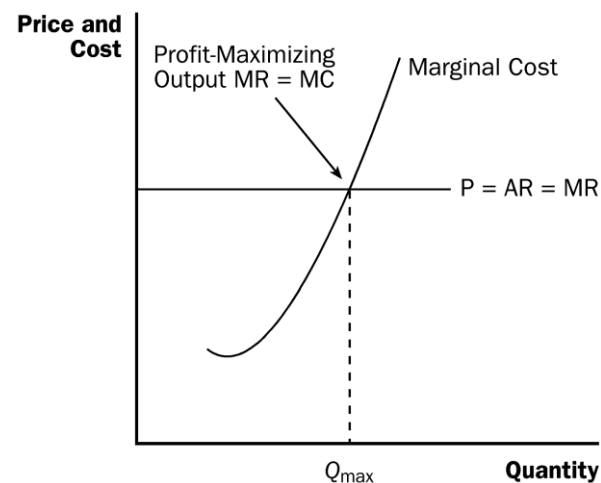
❖ If MR > MC, then increase Q to raise profit.

❖ If MR < MC, then reduce Q to raise profit.

Example 1:

Q	TR	TC	Profit	MR	MC	ΔProfit = MR − MC
0	$0	$5				
2	10	9				
4	20	15				
6	30	23				
8	40	33				
10	50	45				

Example 2:

Assume you're a production manager. Your costs are shown below:

Quantity	Average Total Cost
500	200
501	201

Your current level of production is 500 units. The phone rings. It's a new customer who wants to buy 1 unit of your product and offers you $450.

a. Should you accept this offer?
b. What is the net change in the firm's profit?

Answer:
Selling something for $450 when the average cost of production is $201 seems like good business. They are wrong.

The relevant comparison is MC and MR.

Quantity	ATC	$TC = Q \times ATC$
500	200	100,000
501	201	100,701

$MC = \$100{,}701 - \$100{,}000 = \$701 > MR = 450$

- The offer should not be accepted. It would result in a $251 loss in profits.

2) Shutdown Rules:

In the short-run: The firm should shut down only if the revenue cannot cover its variable cost.

In the long-run: The firm should exit if its profit is negative.

An example:
Suppose FC=3000, VC=1000, R=2000.

If the firm operates, its short-run profit is:
$$\pi = R - FC - VC = 2000 - 3000 - 1000 = -2000$$

If the firm shuts down, its profit is:
$$\pi = -FC = -3000$$

So in the short-run the firm should not shut down, because its revenue covers its variable cost, while its fixed cost is sunk.

IV. Competition In the Short Run (No firms enter or exit the market)

Maximize profit: $\pi(q) = TR(q) - TC(q)$

1. Optimal quantity

$$MR(q^*) = MC(q^*)$$
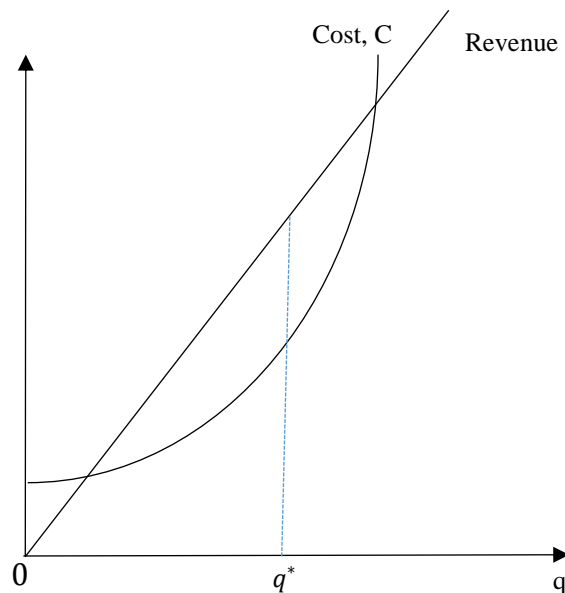
In a perfectly competitive market:
$$MR = P$$

So we have:
$$P = MC(q^*)$$

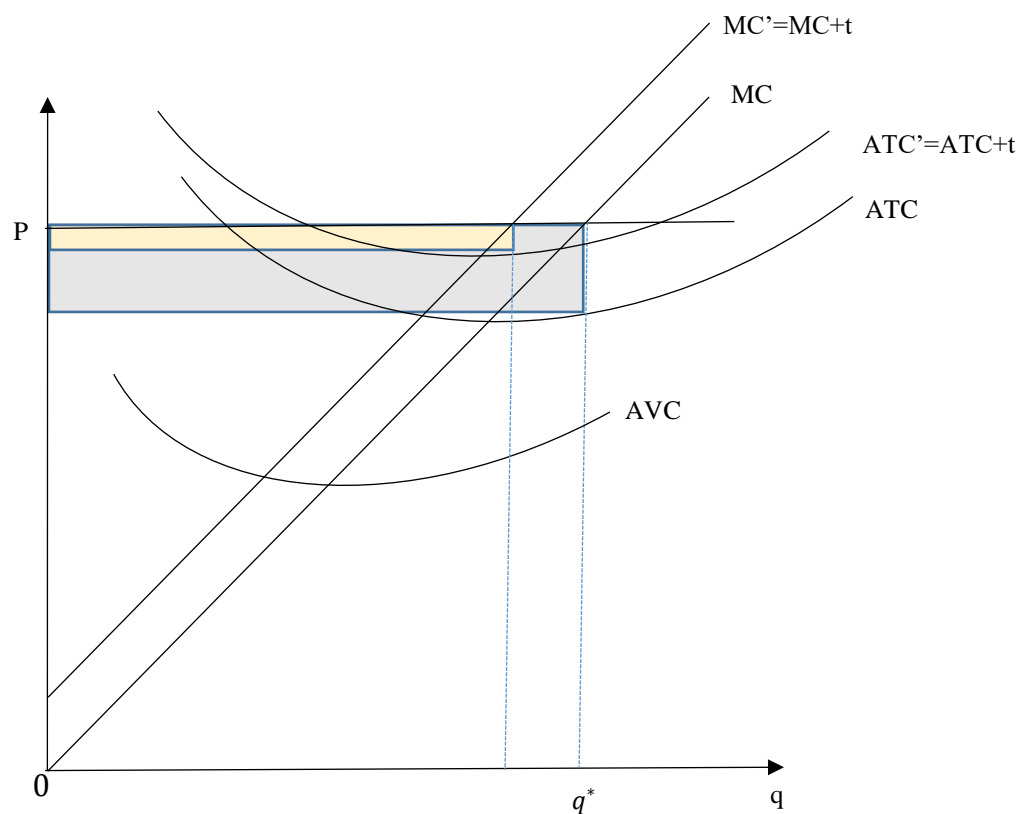An example: $C(q) = 10 + q^2$, $MC = 2q$, P = 6
What is the optimal quantity?
Answer: at the optimal we have
$MC = P$, so $2q = 6 \Rightarrow q^* = 3$.

Question 1: Can you add in the profit curve, MR, MC, and AC curves in the graph above?

Question 2: If now the cost increases by \$t per unit, what is the new cost function, MC, and the optimal quantity? Show them in the graph.

Cost, C   Revenue

0   q^* q

MC'=MC+t

MC

ATC'=ATC+t

ATC

P

AVC

0   q^* q

Measure Profit Using Graphs for the Competitive Firm

Profit = TR − TC
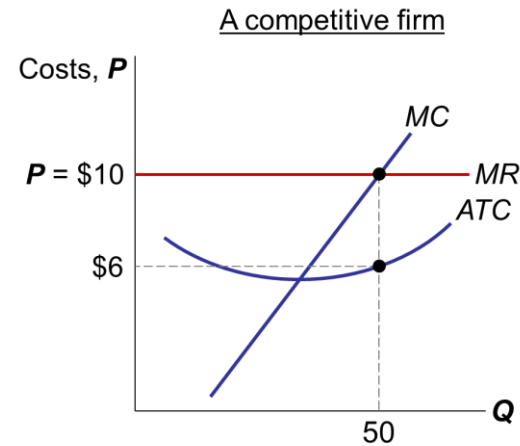
TR = P × Q

TC = ATC × Q

➔ Profit = (P − ATC) × Q

Using this equation, we can measure the amount of profit (or loss) at the firm's profit-maximizing level of output (or loss-minimizing level of output).
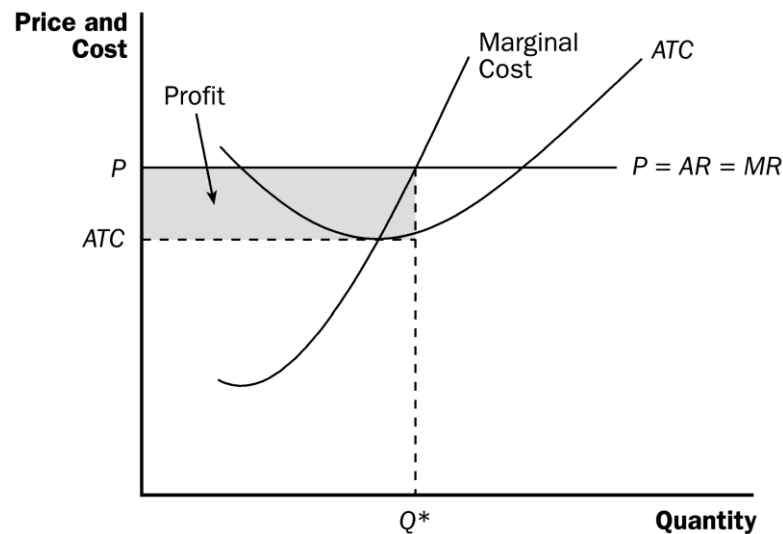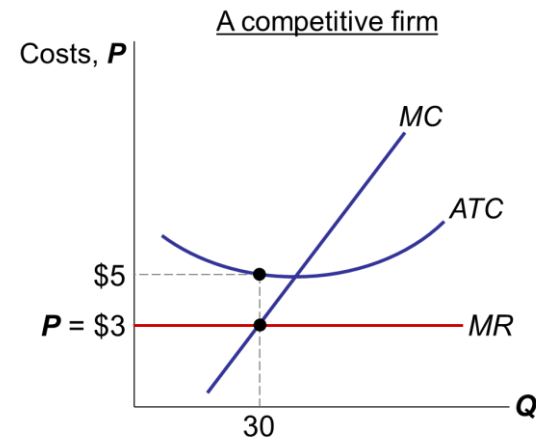

Example:

Determine total profit of the following firms and identify the area on the graph that represents the firm's profit.

1)

A competitive firm

2) Assume AVC < $3 at q=30.

A competitive firm

2. Shutdown Decision

Once we get the optimal q, we should check whether the firm should shut down at the quantity q.

Let's continue the above example:
$C(q) = 10 + q^2$, $MC = 2q$, P = 6
$MC = P$, so $2q = P \Rightarrow q^* = \frac{P}{2} = 3$.
Should the firm shut down?
If the firm shut down: $\pi = p*0 - C(0) = -10$.
Its loss is equal to its fixed cost.
If the profit is positive, the firm should not shut down.

A firm may lose money, but should not shut down. If a firm lose too much money, it should shut down.
What if the price $P = 2$?
The optimal $q^* = \frac{P}{2} = 1$.
If the firm operates: $\pi = pq - C(q) = 2 - (10 + 1) = -9$.
If the firm shut down, from above: $\pi = -10$.
So the firm should operate.

More generally, since the fixed cost is sunk, it should not be considered when a firm is making its decision. So the firm should not shut down if its revenue covers its VC:
$$pq \geq VC \Leftrightarrow$$
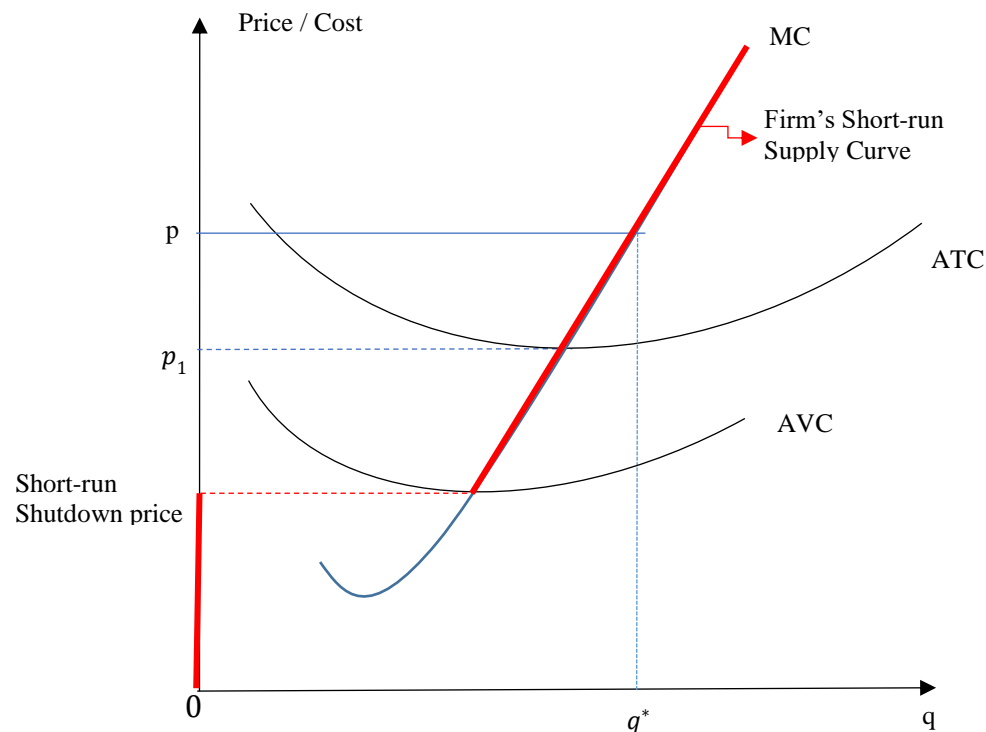$$\boldsymbol{p \geq AVC}$$

In the above example:
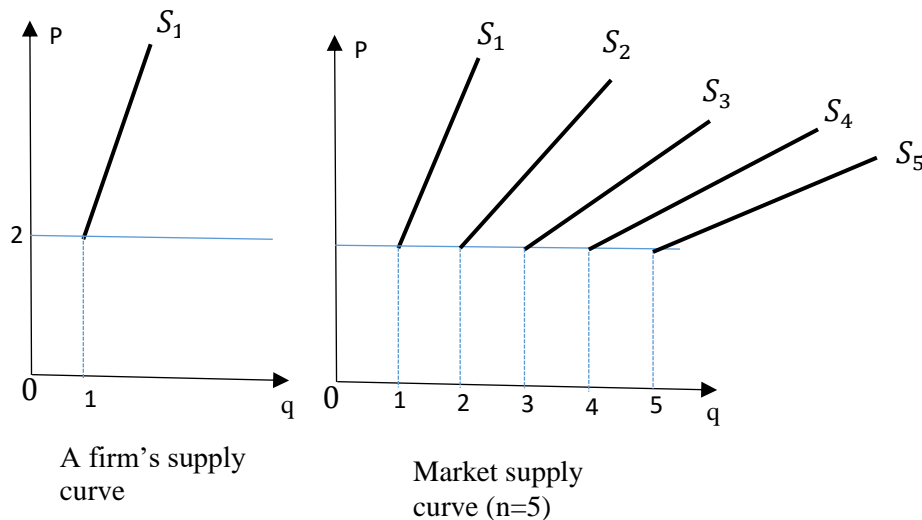$AVC(q) = \frac{q^2}{q} = \frac{p}{2}$, so $AVC(q) < P$
So the firm should not shut down.

3. Individual Firm's Supply Curve
- When the price is higher than min(AVC), the firm's supply curve is identical to the part of MC curve that is above the AVC curve.
- When the price is lower than min(AVC), q=0.

4. Short-Run Market Supply Curve with Identical Firms

A firm's supply curve

Market supply curve (n=5)

Suppose there are n identical firms in the market, at any given price P, the market supply is equal to n times the supply of each individual firm.

- The more firms we have in a market, the more elastic the market supply curve becomes.

5. Short-Run Equilibrium

1) Each firms has a cost function. Given any price P, each firm chooses the optimal q such that $P = MC(q)$. This constructs the firm's supply curve.

2) Add up the firms' supply curves, we get the market supply curve

3) The market price is determined by the intersection point of the market demand curve and the market supply curve.

4) Each firm decide how much to produce at this market price.

Example:
$C(q) = 10 + q^2, MC = 2q$. The demand function is $Q_D = 28 - p$. There are 5 identical firms in the market. Get the market equilibrium in the short-run.

1) Each firm's supply function is: $P = MC = 2q$. Or we can write it as $q = \frac{P}{2}$.

2) Market supply function aggregates all firms' supply: $Q_S = n * \frac{P}{2} = \frac{5}{2}P$.

3) In Equilibrium, $Q_S = Q_D = Q$. So $28 - P = \frac{5}{2}P \Rightarrow P = 8, Q = 20$.

4) At the market price $P = 8$, each firm produces $\frac{P}{2} = 4$.

Note that to find out the equilibrium, we only need the cost function, the demand function and the number of the firms in the market.