Microeconomics

Chapter 13
Competitive markets

Fall 2023

Perfect competition

Perfect competitive markets have two main characteristics:

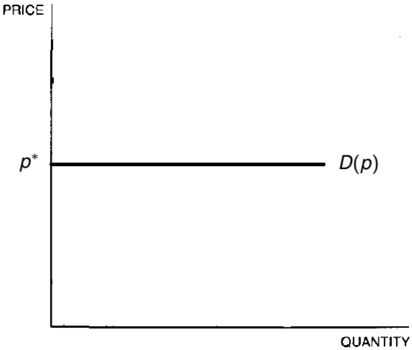
(1) large number of firms that

(2) sell a homogeneous good

This ensures that perfectly competitive firms are **price takers**. Let p^* be the equilibrium market price, then a firm's demand curve $D(p)$ can be characterized as follows:

$$D(p) = \begin{cases} 0 & \text{if } p > p^* \\ \text{any amount} & \text{if } p = p^* \\ \infty & \text{if } p < p^* \end{cases}$$

Demand curve



The **demand curve** for a perfectly competitive firm is horizontal: against the given market price p^* it can sell any amount. Strictly speaking, the graph shows the **inverse demand curve**: price as a function of quantity. One can also graph the **demand curve**: quantity as a function of price.

Perfect competition

In **the long run**, truly competitive markets have a third characteristic:

(3) entry and exit

This ensures that perfectly competitive firms make **zero profits** in the long run. If perfectly competitive firms make positive (negative) profits in the short run, then firms enter (exit) the market and the equilibrium price p^* decreases (increases), until profits are zero.

Supply curve

For a single perfectly competitive firm the price p is given. This makes profit-maximization simple: The firm only has to choose output y as to maximize profits $\pi(y) = py - c(y)$,

$$\max_y py - c(y).$$

Note that $c(y)$ is a cost function as discussed in Chapter 4.

Recall that the FOC for profit maximization was to set the first derivative to zero,

$$\frac{\partial \pi(y)}{\partial y} = p - \frac{\partial c(y)}{\partial y} = 0.$$

Which can be written as,

$$\underbrace{p}_{MR} = \underbrace{\frac{\partial c(y)}{\partial y}}_{MC(y)}$$

Supply curve

Hence a perfectly competitive firm produces output y until $MC(y)$ is equal to the fixed price p:

$$p = MC(y).$$

Intuitively, making an additional y costs $MC(y)$ and selling an additional y generates revenue p, and so if $p > MC(y)$ the firm should make and sell additional y. In turn, if $p < MC(y)$ the firm should make and sell less y.

The FOC pins down the **supply function**: for each price p you can trace out the quantity y so that $p = MC(y)$, which is the quantity the firm will produce.

Strictly speaking, the FOC above gives the **inverse supply function**: $p = MC(y)$ gives p as a function of y. Solving the FOC for y as a function of p gives us the **supply function**: $y(p)$ gives y as a function of p.

Supply curve

A solution to the FOC above with $y(p) > 0$ is an **interior solution**. However, despite a FOC with $y(p) > 0$ a firm may not produce at all with $y = 0$, which is a **corner solution**.

Consider a firm's short-run cost function as follows

$$c(y) = c_v(y) + FC.$$

Note that $c_v(y)$ are the variable costs and FC are the fixed costs.

The firm will only find it profitable to produce the solution to the FOC $y(p) > 0$ if the profits of doing so exceed the profits of producing nothing:

$$\underbrace{p \times y(p) - \left(c_v(y(p)) + FC\right)}_{\pi(y(p))} \geq \underbrace{-FC}_{\pi(y=0)}.$$

Supply curve

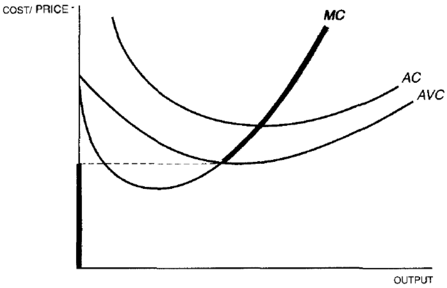
Getting rid of the fixed costs FC on both sides and using that $c_v(y(p)) = AVC(y(p)) \times y(p)$, we can write this as,

$$(p - AVC(y(p))) \times y(p) \geq 0.$$

Hence, if $p \geq AVC(y(p))$ the firm will choose the output y given by the FOC $y(p) > 0$. However, if $p < AVC(y(p))$ the firm will choose $y = 0$ despite a FOC with $y(p) > 0$.

A price that is equal to the average variable cost is often referred to as the **shutdown price**.

The supply curve in a graph



A perfectly competitive firm's **supply function** equals the MC curve as long as the price is above AVC. If the price is below the AVC, then supply shoots to zero. We can summarize this as,

$$y(p) = \begin{cases} 0 & \text{if } p < AVC(y(p)) \\ y(p) & \text{if } p \geq AVC(y(p)) \end{cases}$$

Equilibrium

Recall that each **single firm** is a **price taker**: it takes the **market equilibrium price** p^* as given, which determines their perfectly elastic demand $D(p^*)$ and their supply $y(p^*)$.

However, how is the equilibrium price determined?

Let there be $i = 1, ..., m$ identical firms: same cost functions. Let a single firms' supply curve be denoted by $y_i(p)$. Then the **market supply curve** is

$$Y(p) = \sum_{i=1}^{m} y_i(p).$$

Let there be $j = 1, ..., n$ identical consumers: same preferences. Let a single (Marshallian) demand be given by $x_j(p)$. Then the **market demand curve** is

$$X(p) = \sum_{j=1}^{n} x_j(p).$$

Equilibrium

The **market equilibrium** is a point where **market supply** equals **market demand**:

$$Y(p) = X(p).$$

The equilibrium price $p = p^*$ solves $Y(p^*) = X(p^*)$. This is an equilibrium since at this point no agent has an incentive to unilaterally change its behavior.

It is this equilibrium price p^* that each single firm takes as given, which determines their perfectly elastic demand $D(p^*)$ and their supply $y(p^*)$.

Equilibrium in the long run

Recall the third characteristic of entry and exit in the long run. This guarantees that the **long-run equilibrium** is characterized by two conditions:

$$
\begin{aligned}
Y(p) &= X(p), \\
\pi_i(y_i(p)) &= 0, \quad \forall i.
\end{aligned}
$$

Hence, the long-run equilibrium is additionally characterized by $\pi_i(y_i(p)) = \pi_i(p) = 0$ for all i.

Equilibrium in the long run

Why does entry and exit guarantee that $\pi_i(p) = 0$?

If $\pi_i(p) > 0$ then firms **enter** until $\pi_i(p) = 0$:

$$\pi_i(p) > 0 \rightarrow \text{entry} \rightarrow Y(p) \uparrow \rightarrow p^* \downarrow \rightarrow y_i(p) \downarrow \rightarrow \pi_i(p) \downarrow \text{ until } \pi_i(p) = 0.$$

If $\pi_i(p) < 0$ then firms **exit** until $\pi_i(p) = 0$:

$$\pi_i(p) < 0 \rightarrow \text{exit} \rightarrow Y(p) \downarrow \rightarrow p^* \uparrow \rightarrow y_i(p) \uparrow \rightarrow \pi_i(p) \uparrow \text{ until } \pi_i(p) = 0.$$

Consider that at some point in time $\pi_i(p) = 0$. However, then consumer preferences change so that $X(p) \uparrow$. In the short run it may be that $p^* \uparrow$ since $X(p) = Y(p)$ at higher p, so that $y_i(p) \uparrow$ and $\pi_i(p) > 0$. However, in the long run entry will take place so that $Y(p) \uparrow$ until $\pi_i(p) = 0$.

Equilibrium in the long run

Hence, the **long-run equilibrium** is additionally characterized by $\pi_i(p) = 0$. Recall that the firm's profits can be represented by:

$$\pi_i(p) = p \times y_i(p) - c(y_i(p)).$$

Using that $c(y_i(p)) = ATC(y_i(p)) \times y_i(p)$, we can write the profits as,

$$\pi_i(p) = \big(p - ATC(y_i(p))\big) \times y_i(p).$$

Hence, the **long-run equilibrium price** p^* in a competitive market with entry and exit is as follows,

$$p^* = MC(y_i(p^*)) = \min\big(ATC(y_i(p^*))\big).$$

The price that is equal to the minimum of the average total cost is often referred to as the **break-even price**.

Exercise

Consider a perfect competitive market. Let the cost function of a single firm be equal to:

$$c(y) = y^2 + 1.$$

Let the market demand be given by:

$$X(p) = 10 - p.$$

1. Find the individual's firm supply curve.

2. Consider that in the short run 2 identical firms are active in the market: both firms have the above cost function. Find the market supply curve.

3. Determine the market equilibrium price and quantity with the 2 firms.

4. How much profit do the 2 firms make in the short run? (the solution will not be an integer)

5. How many firms will there be active in this market in the long run? Consider that all potential firms have the same cost function as above.

Homework exercises

Exercises: exercises on the slides