Microeconomics

Chapter 13

Competitive markets

Fall 2024

Perfect competition

Perfect competition has two main characteristics:

(1) large number of firms that

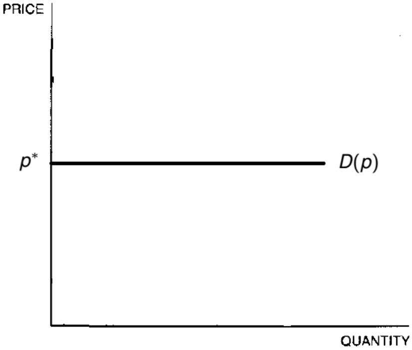
(2) sell a homogeneous good

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:

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

We will later discuss how the equilibrium price p^* is determined.

A firm's demand curve



The demand curve for a perfectly competitive firm is horizontal: against the given market price p^* it can sell any amount.

Note that the graph shows the **inverse demand curve**: price as a function of quantity. Instead, the **demand curve** is: quantity as a function of price.

A firm's supply curve

From the perspective of a single competitive firm, the price p is given. This makes profit-maximization simple: The firm has to **choose output** y as to maximize profits while y does not affect the price,

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

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

The FOC for profit maximization sets the first derivative to zero,

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

Which can be written as,

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

A firm's 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 a **firm's supply**: for each price p you can trace out the quantity y so that $p = MC(y)$, which is the quantity the firm will produce.

Note that the FOC above gives the **inverse supply function**: $p = MC(y)$ gives p as a function of y. Taking the inverse of this FOC gives us the **supply function**: $y = MC^{-1}(p) = y(p)$ gives y as a function of p.

A firm's 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 prefer not to produce at all with $y = 0$, which is a **corner solution**.

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

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

where $c_v(y)$ 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:

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

A firm's supply curve

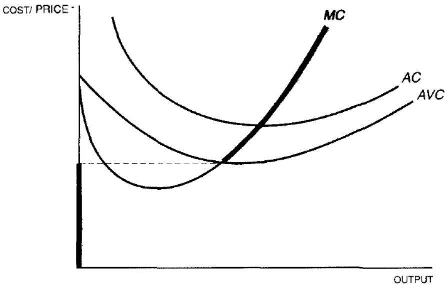
Getting rid of the fixed costs FC on both sides and using that $c_v(y(p)) = AVC(y(p)) \times y(p)$, we can write this as,

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

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**.

A firm's supply curve



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,

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

Market 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 p^* 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

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

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

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

Market 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 $y(p^*)$.

Hence, although each firm's demand $D(p)$ is perfectly elastic, the market demand $X(p)$ is not.

Market equilibrium in the long run

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. Intuitively, 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.

Market equilibrium in the long run

This third characteristic in the long run guarantees that the **long-run equilibrium** is characterized by two conditions:

$$Y(p) = X(p),$$
$$\pi_i(y_i(p)) = 0, \quad \forall i.$$

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

Market equilibrium in the long run

How 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 $\pi_i(p) = 0$.

Market 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 supply 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