MOT1421
Economic Foundations
Week Two

MARKET CO-ORDINATION:
Perfect Competition

S. STORM

LECTURE NOTE MOT1421-W-2A

The Lecture Note MOT1421-W-2A is part of the exam materials.
The required reading for Week 2 consists of:

- This Lecture Note MOT1421 W-2A and Lecture Note MOT1421 W-2B.

Supporting videos:

- https://www.youtube.com/watch?v=ucJBO9UTmwo&list=PLE70CA726102FB294&index=5 this video explains short-run cost curves (in 6 minutes). The next video finishes the discussion on short-run cost curves; https://www.youtube.com/watch?v=qYKJdooEnwU
- https://www.youtube.com/watch?v=LwLh6ax0zTE&list=PL8oXFCVYlVwR8RLfT6piBC2G8GP9ywAxL explains the market-demand curve; and https://www.youtube.com/watch?v=ewPNugIqCUM&list=PL8oXFCVYlVwR8RLfT6piBC2G8GP9ywAxL&index=2 explains the market-supply curve,
- https://www.youtube.com/watch?v=Z9e_7j9WzA0 this video explains short-run equilibrium in perfect competition (in 5 minutes).

These five videos cover most of the theory of perfect competition.

Market Co-ordination:
Perfect Competition

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Introduction

The market mechanism is a device for organizing the production of goods & services and the distribution of income of society. Markets work through rationing (this is one of the most important ideas in microeconomics): the price mechanism is a way of determining who will participate in economic activity as a seller or buyer, and who will not. Let us see how this rationing works in the market for electricity (see Figure A).

Electricity supply is assumed to be a positive function of the electricity price. A higher price will motivate power suppliers to generate and distribute more electricity. The market-supply curve reflects the willingness and ability of electricity producers to supply power to the market: a relatively high price *P* will induce a relative high electricity supply.

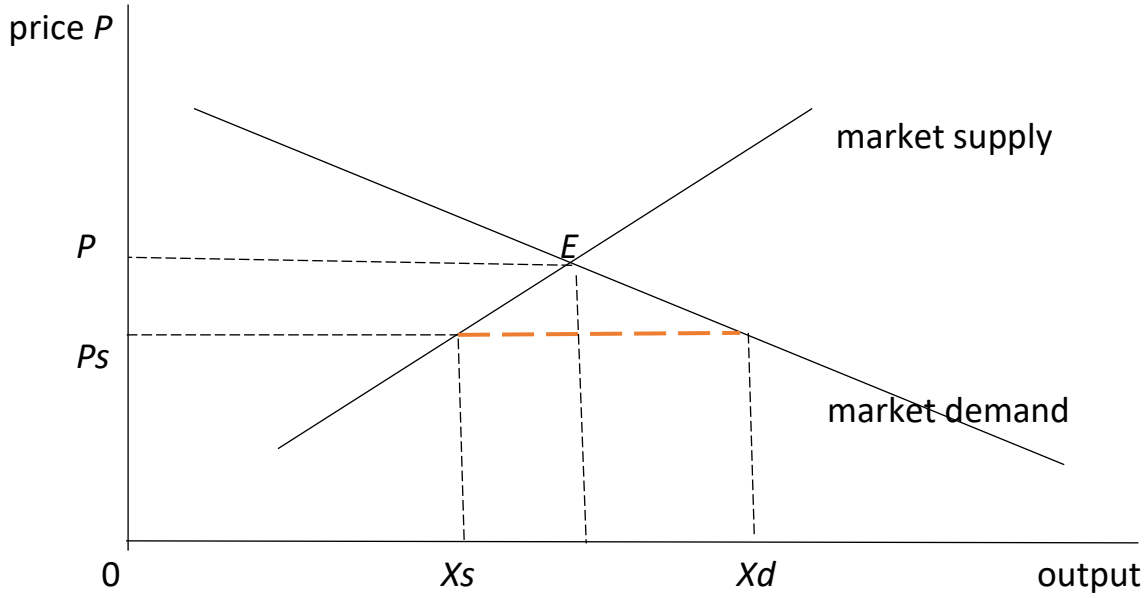
Electricity demand is assumed to be a negative function of the electricity price. A higher price will motivate users/consumers to reduce their electricity demand. The market-demand curve reflects user/consumer preferences and the willingness of users/consumers to purchase electricity at a given price: a relatively high P will induce a relatively low electricity demand.

The price mechanism brings about equilibrium or a balance between demand and supply. Let us see how this works in Figure A. We start by assuming that electricity producers have decided to produce *Xs* units of electricity, which they want to sell. Based on the market-supply curve, we can see that the electricity producers will be willing to sell *Xs* at the price *Ps* (as this price would cover their marginal production costs). However, if the electricity producers announce that they are willing to sell power at the price *Ps*, users/consumers will react by demanding *Xd* units of electricity (based on the demand curve). The positive difference between *Xd* and *Xs* is an (unmet) excess demand. Producers notice the excess demand and are quick to understand that in these circumstances they can get a higher price – hence, producers will charge a higher *P*.

It should be clear from Figure A that the higher *P* raises market supply (we move up along the market-supply curve in the direction of point *E*) and reduce market demand (we move up the market-demand curve in the direction of point *E*). This price-adjustment stops once we reach the equilibrium price *P*, at which *Xd* = *Xs*.

This is the price mechanism, also known as the 'invisible hand', which clears the electricity market.

Figure A



So where is the rationing? All users/consumers who would be willing to buy electricity at a price below the equilibrium price *P* are rationed – they will not purchase the electricity as it is too expensive. All producers willing and able to supply at a price above *P* are also rationed – the market is not supporting their activity and they have to stop production.

However, not all markets operate in the same manner. In micro-economics, we distinguish different market structures: perfect competition, oligopoly and monopoly.

Structure-Conduct-Performance

The structure–conduct–performance (S-C-P) paradigm is a model in micro-economics which offers a causal theoretical explanation for firm performance through economic conduct in a particular market structure. According to the S-C-P paradigm, market structure conditions the firm's economic conduct (decision-making), which in turn affects its market performance. Additionally, external factors such as legal or political interventions affect the market

framework and, by extension, the structure, conduct and performance of the market. More specifically, we define:

- **structure**: market structure influences the nature of competition and the method of fixing the price of goods or products exchanged in a strategic way. The structure of the market as part of the S-C-P model therefore consists of the numbers of buyer and sellers, barriers to entry, product differentiation and the vertical integration of firms. The structure of the market is also influenced by the nature of the product and the technology available.
- **conduct**: the behaviour of firms in the market concerns the strategy of fixing prices and the volumes produced, investment in marketing and advertising, internal growth (R&D, innovation strategy, investment), and external growth (merger/acquisition, agreement, cooperation).
- **performance**: the criteria of evaluation of market performance are, therefore, prices, costs of commercialisation and commercial margins. We can add the quality of products, the efficiency of production, the allocative efficiency of resources, technical progress and the evolution of the market shares of firms.

Perfect competition, oligopoly and monopoly

In this course we will analyse firm behaviour and decision-making in three market structures: (1) a market of perfect competition; (2) oligopoly; and (3) monopoly. Each market structure will be analysed in a formal and detailed manner. Here, to begin with, we summarize the key assumptions underlying the economic models of perfect competition, oligopoly and monopoly – in Table 1.

Table 1: Three Market Structures Compared

	perfect competition	oligopoly	monopoly
Structure	Large numbers of buyers and sellers; no market concentration	A few suppliers and a large number of buyers. Supply is concentrated in a few firms.	One seller/supplier and a large number of buyers. Supply is concentrated in one firm.
	Firms do not have market power; firms are price-takers.	Firms have market power, but have to reckon with what other firms do (strategic inter-dependence); firms either decide the quantity of output or the price.	The monopolistic firm is a price-setter or determines the quantity of output; the firm has market power.
	All firms use the same technology; cost functions are identical across firms.	Firms may use the same or different technologies; cost functions may be similar or different.	The monopolistic firm uses a given technology and has given cost functions.
	All firms produce identical goods. There is no product differentiation.	In some oligopolistic markets, firms produce identical goods, but in other markets, firms produce differentiated goods.	The monopolistic firm produces one specific good/service. The monopolist can engage in product differentiation.
	Entry into and exit from this market are free and costless.	Entry into and exit from these markets may be free and costless, but incumbent firms may deter or block potential entrants.	Entry into the market is blocked – by law, license or by the action of the incumbent firm.
	All market actors have perfect information; the market is transparent.	All market actors have perfect information; the market is transparent.	All market actors have perfect information; the market is transparent.
Conduct	Firms aim for maximum profits	Firms aim for maximum profits	The firm aims for maximum profits
Performance	In long-run equilibrium, the market price = average cost; firms only have normal profits.	In general, the market price will exceed average cost and firms make super-normal profits (but smaller than those in monopoly).	In equilibrium, the market price will normally be higher than average cost; firms make super-normal profits.
	Consumers therefore pay the lowest possible price – and consumer welfare is highest.	Consumers pay more than in perfect competition, but less than in monopoly.	Consumers therefore pay a high price – and consumer welfare is lowest.

Perfect Competition

Perfect competition is a market structure characterised by a complete absence of rivalry or competition. Perfect competition therefore has a meaning in economic theory which is diametrically opposed to the everyday use of the term.

Assumptions

The model of perfect competition is based on the following assumptions:

- (very) large numbers of sellers and buyers. The sellers (firms) are so numerous that each individual seller, however large, supplies only a small part of total market supply and has no power to set or influence the market price. Each single firm cannot affect the price in the market by changing its output. The buyers are so numerous that no single buyer is large enough to influence the working of the market. Each individual firm is a price-taker (not a price-setter).
- The market is defined in terms of a homogenous (identical) product. The technical characteristics of the product as well as the services associated with its sale and delivery are identical. This means that (by assumption) there is no product-differentiation.
- All firms use exactly the same technology to produce the same good/service. This means that the (total, average and marginal) cost functions are the same for each firm.
- The goal of all firms (*ex hypothesi*) is profit maximization. No other goals are pursued.
- Free (costless) entry and exit of firms. There is no barrier to entry or exit from the market. (This assumption is supplementary to the first assumption of large numbers of sellers and buyers).
- Perfect knowledge, full transparency and complete information: all sellers and buyers have complete knowledge of the prevailing (and future) conditions of the market. Uncertainty is ruled out by assumption. There is also no asymmetric information, no insider knowledge etc.

Under the above assumptions we will examine the short-run and long-run equilibrium of the firm and the market.

Short-run equilibrium in a perfectly competitive market

Let us look at one – representative (because firms are identical) – enterprise in detail. The firm (firm *i*) is assumed to aim for maximum profits. Profits of firm *i* Π_i are defined as the difference between total revenue (TR_i) and total cost (TC_i) of firm *i*:

$$\Pi_i = \mathrm{TR}_i - \mathrm{TC}_i$$

By definition, <u>total revenue</u> TR_i is equal to: $\mathrm{TR}_i = P \times x_i$, where *P* = the market price, and x_i is the quantity of output of firm *i* (or the number of goods produced and sold). Let us here note that firm *i* has no price-setting power (by assumption) and hence it has to accept the market price, whatever its level. This means that the market price *P* is exogenous to the price-taking firm.

We further assume that <u>total cost</u> is a function of the quantity of output, or:

$$\mathrm{TC}_i = f(x_i)$$

It follows from the above that firm i's <u>profits are a function of its output</u>, because we can write:

$$\Pi_i = \mathrm{TR}_i - \mathrm{TC}_i = P \times x_i - f(x_i)$$

The firm aims at the maximization of its profits. Using the profit function to find maximum profits, the first-order condition for the maximization of a function tells us that its first derivative (with respect to x_i in our case) be equal to zero. Differentiating the profit function and equating to zero we obtain:

$$\frac{\partial \Pi_i}{\partial \mathrm{x}_i} = \frac{\partial\, \mathrm{TR}_i}{\partial \mathrm{x}_i} - \frac{\partial\, \mathrm{TC}_i}{\partial \mathrm{x}_i} = 0 \quad \rightarrow \frac{\partial\, \mathrm{TR}_i}{\partial \mathrm{x}_i} = \frac{\partial\, \mathrm{TC}_i}{\partial \mathrm{x}_i} \quad \rightarrow \quad MR_i = MC_i$$

The derivative of total revenue with respect to output, $\frac{\partial\, \mathrm{TR}_i}{\partial \mathrm{x}_i}$, is called <u>marginal revenue</u> (MR_i). MR_i is the extra revenue the firm obtains by producing and selling one additional unit of output. Because (in perfect competition) firm *i* is a

price-taker, $\frac{\partial \mathrm{TR}_i}{\partial \mathrm{x}_i} = P$; since firm *i* can always sell one extra unit of output at the market price *P*, its marginal revenue is equal to *P*.

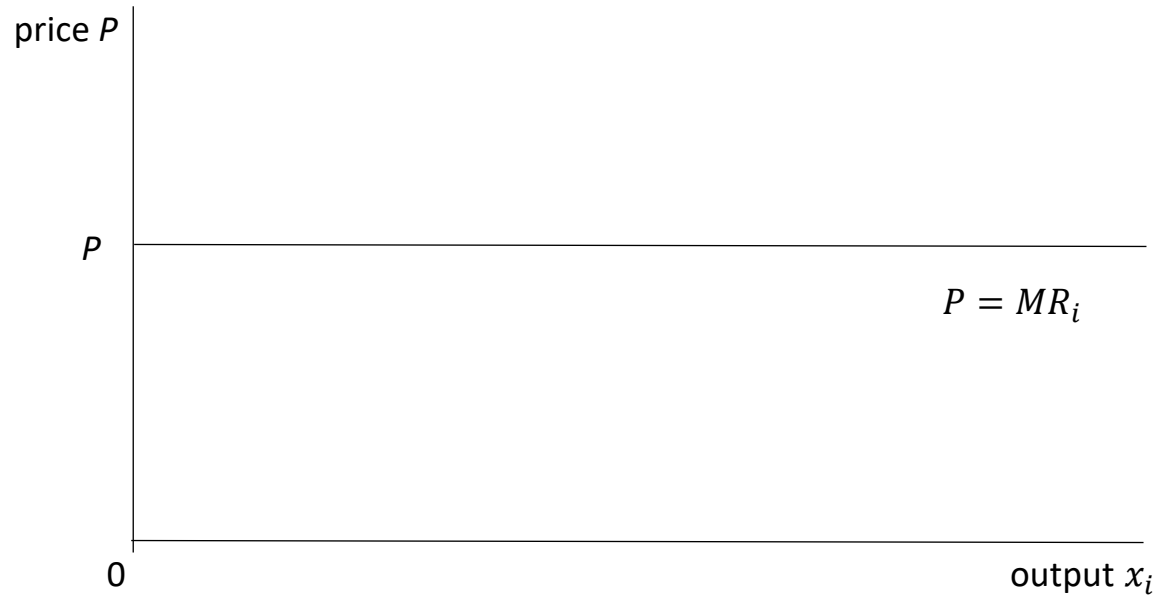
The derivative of total cost with respect to output, $\frac{\partial \mathrm{TC}_i}{\partial \mathrm{x}_i}$, is called <u>marginal cost</u> (MC_i). MC_i is the additional cost the firm incurs to produce one extra unit of output.

The profits of firm *i* are maximum at that level of output x_i at which $MR_i = MC_i$. Let us try to understand why this is the case. Assume that $MR_i > MC_i$. If this holds true, the extra (marginal) revenue by producing and selling one extra unit of output will be higher for firm *i* than the additional (marginal) cost of doing this. Clearly, firm *i* can raise profits by stepping up production. However, if the firm finds that $MR_i < MC_i$, it should realize that it can increase profits by lowering its output; the reason is that the extra cost of producing one extra unit of output exceeds the additional revenue the firm is obtaining. Profits are maximized at that (unique) level of output at which $MR_i = MC_i$.

Marginal revenue

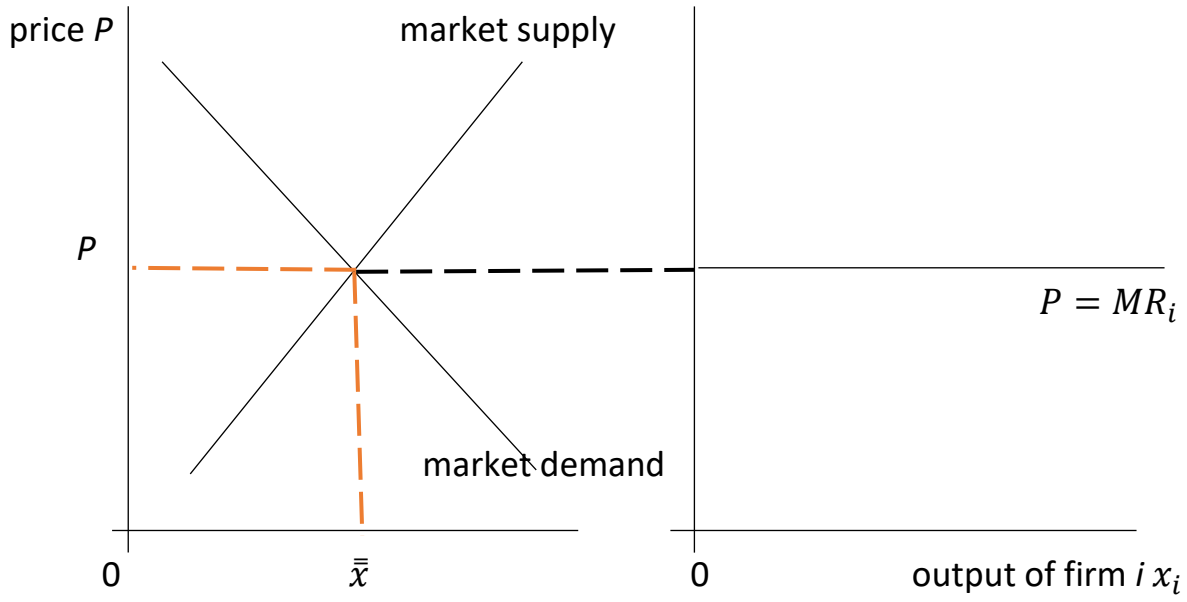
Let us first consider <u>marginal revenue</u>. In perfect competition, $MR_i = \frac{\partial \mathrm{TR}_i}{\partial \mathrm{x}_i} = P$. The individual firm in perfect competition is a <u>pure price-taker</u>; it can sell any amount of its output at the prevailing market price (Figure 1).

Figure 1



Where does the (prevailing) market price come from? The answer is: the market price is determined by market demand (coming from buyers) and market supply (which is the supply of all firms combined). The prevailing market price is the price which clears the market, i.e. the price at which the quantity demanded in the market is equal to the quantity supplied. In Figure 2, the market is in equilibrium at price *P*, at which buyers (consumers) demand quantity $\bar{\bar{x}}$ and sellers (producers) supply quantity $\bar{\bar{x}}$.

Figure 2



Market demand depends on the income of the buyers and on the price of the good/service. In Figure 2, the market-demand curve is downward-sloping in price (on the vertical axis), which means that buyers increase their demand for this particular item in response to a decline in price. Market supply is an upward-sloping curve in Figure 2, which indicated that producers will raise their supply to the market in response to a higher price. Market equilibrium occurs at price *P*, at which market demand = market supply. If the price is below *P*, demand will exceed supply (there is excess demand); this will push up the price, due to which demand will decline and supply will rise – until the market price is equal to *P*. If the price is (for some reason) higher than *P*, supply will be higher than demand

(there is excess supply); this will push down the price, with the result that market demand will rise and market supply will decline – until the market price is equal to the equilibrium price *P*.

The (small) individual firm has to adjust to whatever the equilibrium price *P* turns out to be. Firms in perfect competition are price-takers; the price itself is determined at the aggregate level of the market and is beyond the control and/or influence of any individual supplier.

Marginal and average cost of production

We now consider marginal cost. To derive an expression for marginal cost, we must know the total cost function $\mathrm{TC}_i = f(x_i)$. We will follow microeconomic textbooks and assume the following cubic polynomial total cost function:

$$TC_i = b_0 + b_1 \times x_i - b_2 \times (x_i)^2 + b_3 \times (x_i)^3$$

The constant term b_0 represents total fixed costs (TFC) which include the annualized investment expenses (on machines & equipment, buildings and land) and depreciation (wear and tear) of machinery. (Another factor that may be treated in the same way as fixed costs is the normal profit, which is a fixed return on fixed capital plus an allowance for risk; more on this below). The key point about TFC is that the firm has to pay these costs also when it is not producing anything.

The term $b_1 \times x_i - b_2 \times (x_i)^2 + b_3 \times (x_i)^3$represents total variable costs (TVC) which include the cost of raw materials and intermediate inputs as well as the cost of direct (production) labour. The key feature of TVC is that it is zero when the firm is not producing.

We derive the marginal cost function by differentiating the TC-function with respect to x_i; we thus obtain:

$$MC_i = \frac{\partial\, \mathrm{TC}_i}{\partial \mathrm{x}_i} = b_1 - 2 \times b_2 \times x_i + 3 \times b_3 \times (x_i)^2$$

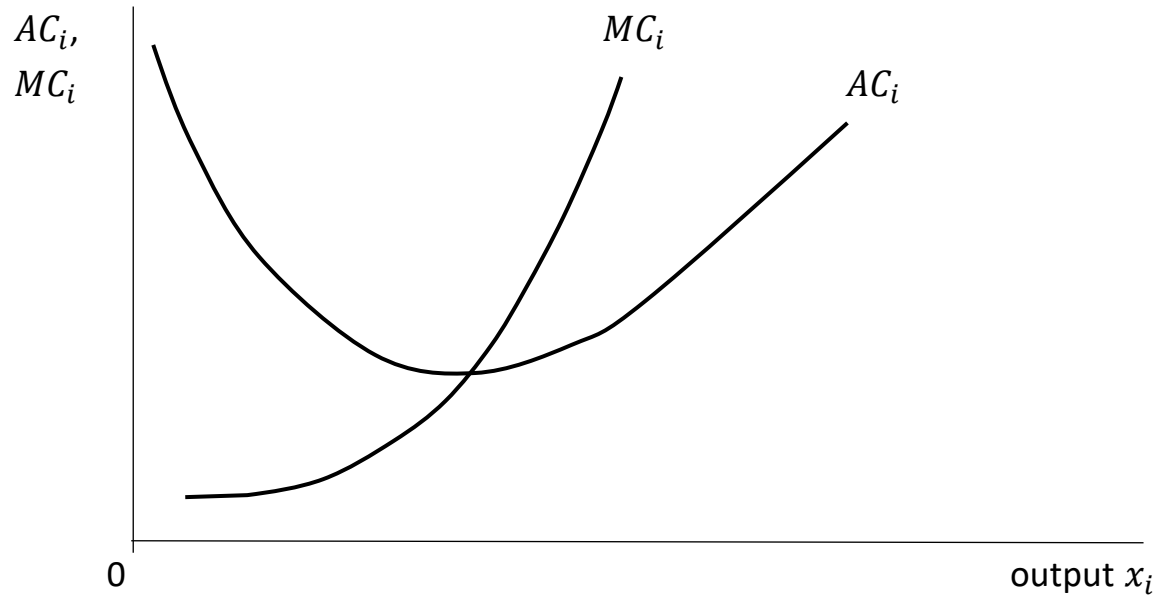
It can be seen that TFC do not feature in the marginal cost function. The marginal-cost curve is U-shaped (see Figure 3).

Based on the total cost function, we can also define the <u>average cost</u> of production (AC_i) as follows:

$$AC_i = \frac{\mathrm{TC}_i}{\mathrm{x}_i} = \frac{b_0}{\mathrm{x}_i} + b_1 - b_2 \times \mathrm{x}_i + b_3 \times (x_i)^2$$

The average-cost curve is also U-shaped (see Figure 3). The MC_i-curve intersects the AC_i-curve at its minimum point. So long as the MC_i-curve lies below the AC_i-curve, it pulls the latter downwards; but when the marginal-cost curve rises above the AC_i-curve, it pulls the latter upwards. This can be understood by an analogy: suppose your average grade for five courses is 6 and suppose your grade for the sixth course is a 4; the additional (marginal) grade is lower than your average grade and hence it pulls the average down. Once you obtain a marginal grade higher than the average, the extra grade will pull the average grade up. The same logic applies to marginal and average costs.

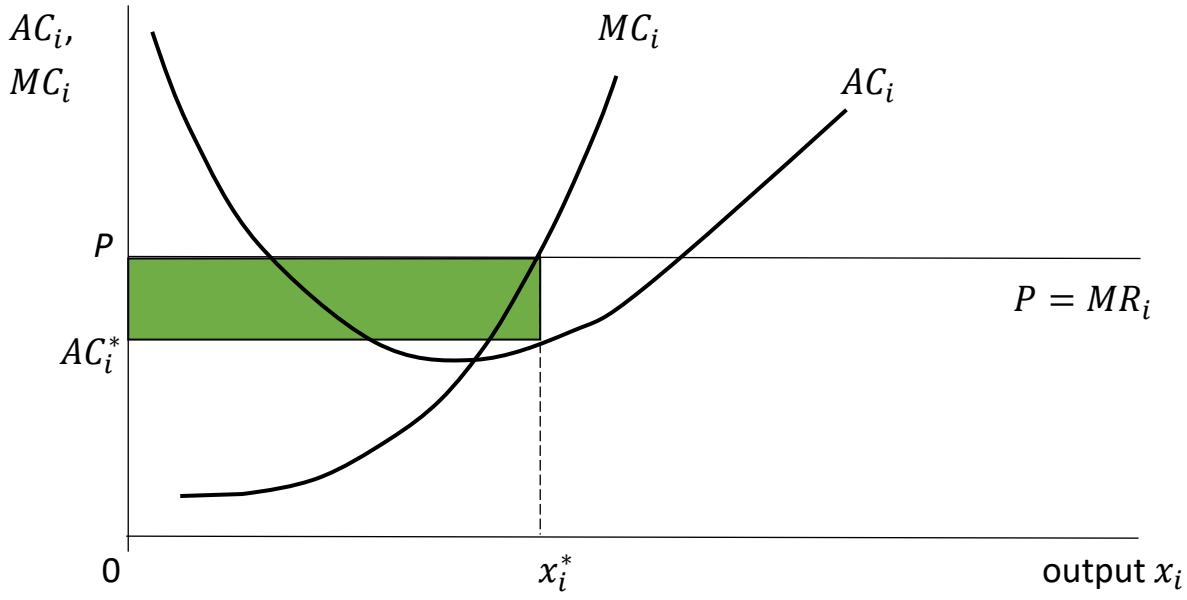
Figure 3



Short-run profit maximization by the firm in perfect competition

In Figure 4, we combine marginal revenue (from Figure 1) and marginal and average cost (from Figure 3). We know that if firm *i* wants to maximize profits, it has to identify the level of output defined by the intersection of its marginal-revenue curve ($P = MR_i$) and its marginal-cost curve. This level of output is shown as x_i^* in Figure 3. To the left of x_i^*, profits have not yet reached their maximum level because each extra unit of output to the left of x_i^* brings to the firm an extra revenue which is greater than its marginal cost. To the right of x_i^*, each additional unit of output costs more than the revenue earned by its sale, which reduces total profits. Only at x_i^* , short-run profits are maximized. This is true for all firms in this market (since they are identical *ex hypothesi*).

Figure 4



The green rectangular area in Figure 3 represents the magnitude (in euros) of maximum short-run profits. Profits are equal to the difference between total revenue and total costs, and hence we have:

$$\Pi_i = \mathrm{TR}_i - \mathrm{TC}_i = P \times x_i - AC_i \times x_i = (P - AC_i) \times x_i$$

Maximum short-run profits are therefore equal to: $\Pi_i = (P - AC_i^*) \times x_i^*$.

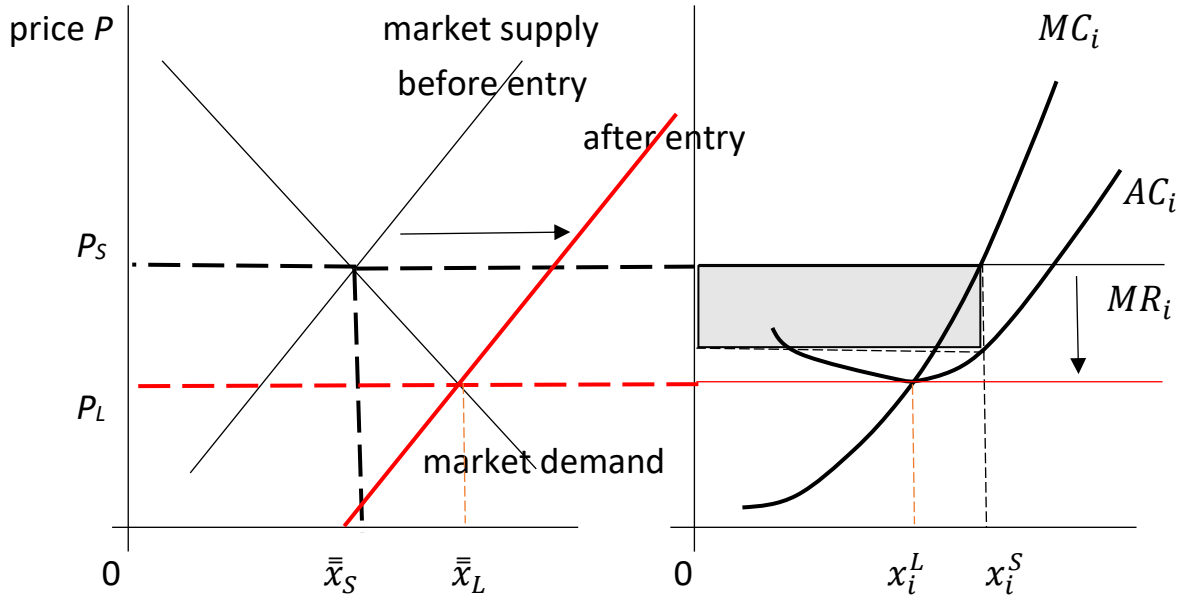
Long-run profit maximization by the firm in perfect competition

The outcome in Figure 4 is a short-run equilibrium, however; it is an equilibrium which will not last in a market of perfect competition. The reason is that each firm is making excess profits $\Pi_i = (P - AC_i^*) \times x_i^*$ at the prevailing market price P which is higher than AC_i^*.

The excess or supernormal profits attract new firms (profit-seeking entrants) in the market. This entry will lead to a fall in price until a long-run equilibrium is reached in which firms will just be earning normal profits and there will be no entry (or exit) from the market. The mechanics is illustrated in Figure 5.

The starting point is the short run equilibrium featuring equilibrium price P_S. At this price, each firm is making supernormal profits (the shaded rectangular area in Figure 5), because $P_S > AC_i$. For each firm, the profit-maximizing level of output is x_i^S. The presence of supernormal profits leads to the entry of new (small) firms; after all, the market is transparent, all is known to everyone inside and outside the market, and entry is free & costless. As a result of the entry of large numbers of new firms (all clones of the incumbent firms, and all working with the same average and marginal cost functions), the market-supply curve will shift to the right – which indicates that for the same P, market supply will be higher (because the number of firms in the market has grown).

Figure 5



As a result (and as can be seen in Figure 5), the market equilibrium price will decline. Each (old and new) firm will have to adjust to a lowered price – and hence a lowered marginal revenue. Due to the decline in the market price, the marginal-revenue curve for each firm will shift down (in the right-hand panel of Figure 5). The marginal and average cost curves do not shift or change location. What happens as the *MR*-curve goes down is two things: (a) the profit-maximizing level of output will go down; and (b) the area of supernormal profits will be reduced.

The entry of new firms will continue, and the market-supply curve will continue to shift to the right, until there are no longer any supernormal profits to be made in this market. This occurs when the market equilibrium price has gone down to the point of intersection between the *MC*-curve and the *AC*-curve (in Figure 5), which is the minimum of the average-cost curve. This brings us to the condition for long-run equilibrium in perfect competition:

$$P = MC_i \quad = AC_i$$

Each firm adjusts its plant size so as to produce that level of output at which the *AC* are the minimum possible, given technology, and the equilibrium price is equal to marginal cost as well as average cost. Under these conditions, there is no further entry or exit of firms in the market.

In theory, the long-run outcome of a perfectly competitive market is argued to feature the following economically desirable properties:

- The output is produced at the minimum feasible cost of production, since $P = AC_i$ for each firm. Consumers therefore pay the lowest possible price – and consumer welfare is highest.
- Production plants are used at full capacity (in the long run), so that there is no waste of resources or slack in the system. Firms only earn normal profits (and not excess or supernormal profits).

Normal versus super-normal profits

In Figure 4, firms make supernormal profits $\Pi_i = (P - AC_i^*) \times x_i^* > 0$ in the short run. Supernormal profits arise from the fact that $P > AC_i^*$, i.e. firms enjoy a (profit) margin on top of their average production costs. These average production costs are assumed to include a normal profit, which is a fixed return on fixed capital & equipment plus an allowance for risk. Hence, if $P > AC_i^*$, firms are not just earning normal profit, but additional – called supernormal – profit.

Firms operating in monopoly or in oligopolistic markets normally make supernormal profits, because these firms have price-setting power as well as the power to block new entrants from coming in the market. These firms are big enough to wield power over the equilibrium market price – and therefore these firms can impose a supernormal profit margin.

Firms in perfect competition are small (relative to the aggregate market) and utterly lack price-setting power; they are price-takers and they cannot deter or block entry. As a result, firms in perfect competition can enjoy positive supernormal profits for some time (in the short run, as in Figure 4), but not permanently. Due to entry, the increase in market supply and the decline in P, these firms in perfect competition end up with just 'normal profits' in the long run, as $P = AC_i^*$.

Limitations of the Theory of Perfect Competition

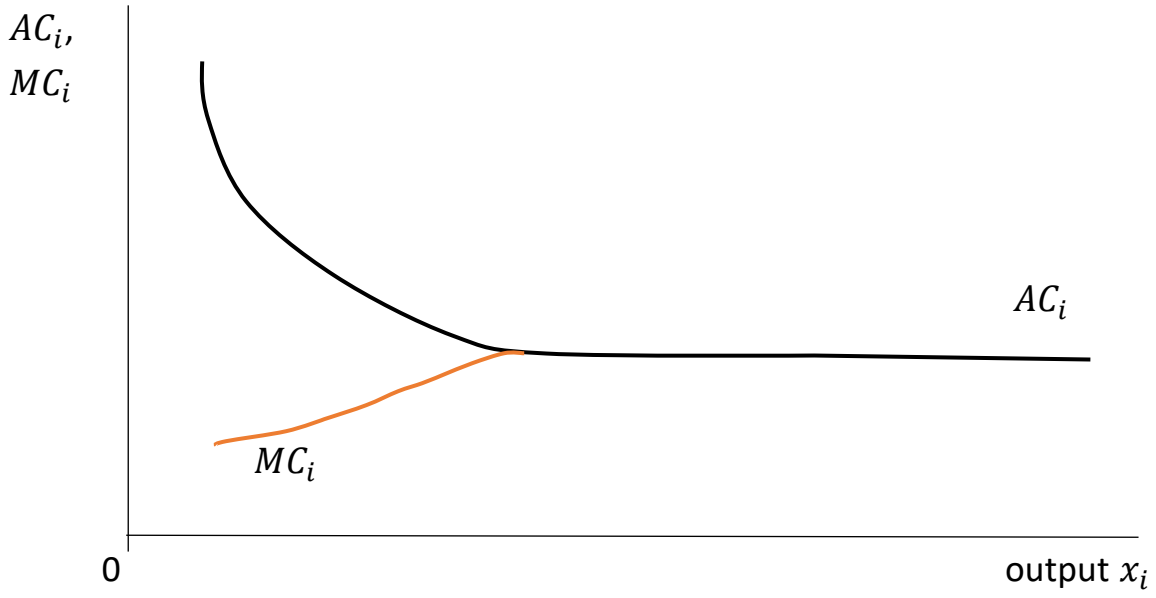
The model of perfect competition suffers from significant drawbacks including the following ones:

- The assumptions defining 'perfect competition' are restrictive and unlikely to be satisfied in reality. It is difficult to find real-world examples of markets in which all firms are identical, use the same technology, produce homogenous goods/services, have all the information, and can enter/exit without (legal & other) barriers and costs. Deviations from the 'normative' model of perfect competition are discussed below (see: "Where the (perfect) market fails").
- Perfect competition is a market structure characterised by a complete absence of competition. Firms do not actually compete. They cannot

innovate to cut cost (in a transparent market, all firms would imitate the innovation without cost); they cannot differentiate their products (if they would, the market would no longer be 'perfect'); they cannot lower price, because $P = AC_i^*$ and hence they would not even break-even (i.e. recoup their cost), which their shareholders would not accept; they cannot be entrepreneurial because they the only degree of freedom they possess in this market structure is the decision to determine the level of output and this each firm can decide in isolation (without bothering about what its competitors might do). Joseph Schumpeter argued that there is no real competition in perfect competition.

- The U-shaped average and marginal cost curves of traditional micro-economic theory have been questioned, both on theoretical and empirical grounds. Empirical evidence suggests that cost curves are L-shaped (rather than U-shaped) and there are solid theoretical grounds to argue against U-shaped *MC*- and *AC*-curves – for instance, due to economies of scale and technological progress, average costs continue to fall, at least over the scales of production which have been operated in the real manufacturing world. More realistic *MC*- and *AC*-curves appear in Figure 6.

Figure 6



In view of these limitations, it is hard to claim that the model of perfect competition is describing a real-world market. In effect, economists (of the neoclassical persuasion) use the market of perfect competition as a normative 'ideal-type' – a theoretical/hypothetical benchmark against which the performance of really existing market structures (such as monopoly and oligopolies) can be evaluated. Other economists reject the model of perfect competition for its un-realism.

Where the (perfect) market fails

The assumptions underlying the market of perfect competition are restrictive and unlikely to be met in reality. We must therefore round our understanding of the perfectly competitive markets by probing five cases in which the market works inefficiently or not at all. These five cases are all called 'market failures', when viewed from the vantage point of 'perfect competition'.

1. Information problems: asymmetric information and ignorance

In the model of perfect competition, it is assumed that all sellers and buyers will have at least roughly accurate information about the market (i.e. about the quantity supplied, cost of production, consumer preferences and demand, etc). But often market participants do not have adequate information – and guide themselves by hearsay, by casual information picked up somewhere, or by their susceptibility to authority and/or advertising. Market actors may be ignorant. The lack of information can be remedied, at least up to a point; but the remedy costs money and/or time (and time = money). The question arises whether it is rational to spend money/time to acquire (market-relevant) information? As a result, a certain amount of ignorance always remains in all markets – which causes equilibrium prices and quantities to deviate from what they would be if we had complete information. Perfect competition is no longer perfect (as it were).

A more specific but very general market failure is caused by the presence of asymmetric information. Asymmetric information arises when one market actor

(say the seller of complex financial derivatives such as options, mortgage-backed securities or interest rate swaps) has more knowledge about the quality or cost of the product (here: the risk that the derivative will default) than the buyer of the product. The seller can rig the market process by understating the riskiness of the financial derivative in order to persuade prospective buyers to purchase the financial instrument. This is called moral hazard: the possibility that the actor with the information advantage will use this for his/her own benefit. This (financial) market failure happened before the Great Financial Crisis of 2008 – and we all know where it led to.

2. Market instability: expectations, cobwebs and speculation

We have thus far assumed that markets gravitate to an equilibrium price which clears the market. In case of an excess supply, the price will decline; supply will go down, while demand will go up – until we reach the equilibrium price P at which market demand = market supply (Figure 2). However, markets may not equilibrate if information market actors have is faulty. Instead, these markets may gyrate or race back and forth, which happens with the stock market when financial investors are particularly 'nervous' about the future. One special kind of market instability is called a cobweb. Figure 7 illustrates the mechanics of an 'explosive' cobweb.

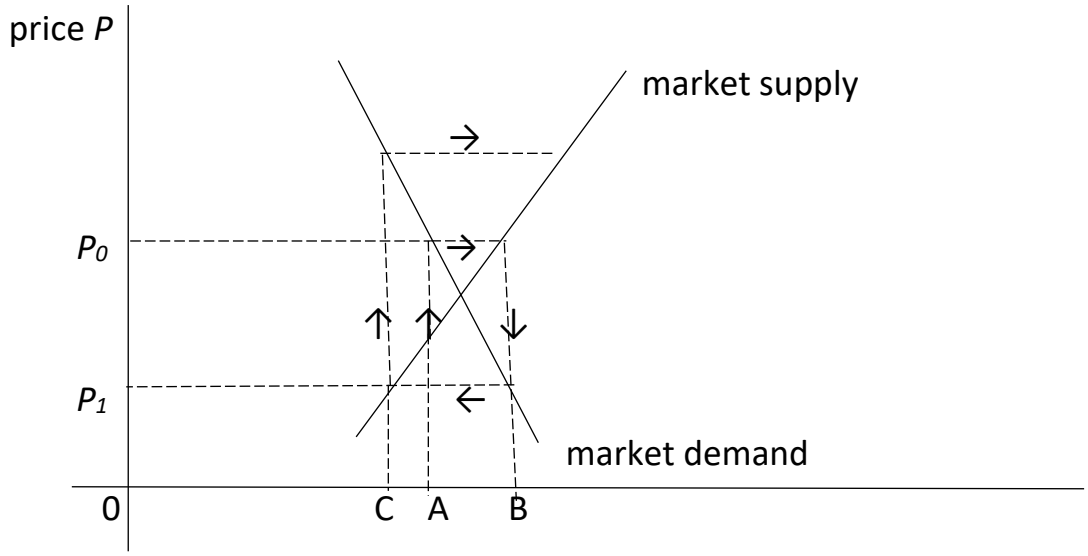
In Figure 7 we show the market for some natural resource (oil) that is extracted and produced a long time before it is sold, so that producers cannot quickly change their outputs in response to changes in market demand. These producers have to gear production to the demand they expect (say) one year into the future. If these expectations are wrong, trouble can ensue.

We begin by supposing that oil producers initially put the quantity OA on the market. Quantity OA will sell at (a high) price P_0. Figuring that P_0 will also be *next year's price*, oil producers now extract and process the quantity of oil they are willing and able to offer at price P_0, which is quantity OB. Alas, in the next year, it turns out that buyers are only willing to purchase OB at a much lower price - P_1. Oil producer now expect that next-year's price will be P_1 – and hence they will cut back production to OC (from a level OB this year). The supply of oil goes

down, creating shortages and an excess demand: the market price will go up. Instead of converging to a stable equilibrium outcome, the market mechanism generates an explosive cycle of over- and undersupply and price instability. A clear market failure – this time due to incorrect expectations.

Similar cumulative and unstable processes can occur due to speculation: if oil prices are rising and market actors believe the oil price hike will last, financial speculators can purchase options (to buy oil at a given price at a future date); this may reinforce the general sentiment that oil prices will continue to increase, and more and more market participants will try to hoard oil or hedge against the price increase – which will just reinforce the disequilibrium process.

Figure 7



3. Market power: monopoly & oligopoly

A most common violation of one of the assumptions of the model of perfect competition occurs when firms have price-setting power, i.e. these firms are big enough to exert a direct or indirect influence on the market price. This is the case in a monopoly (in which there is one single supplier/seller, catering to market demand) and in oligopolies (in which market supply is concentrated and a few (big) producers dominate the supply-side). The theory of monopoly will be discussed in week 2; and a model of non-cooperative oligopoly in week 3.

In all imperfectly competitive markets, output is lower (the product is underproduced) and price P is higher than it would be under (hypothetical) perfect competition. Because of market power, in equilibrium $P > AC$.

4. Externalities

The next instance of market failure is called the problem of allowing for the 'externalities' of production: the unpaid-for (or uncompensated) effects of the production of goods and services on persons other than those who are producing and selling these goods and those who are directly buying or using the goods in question.

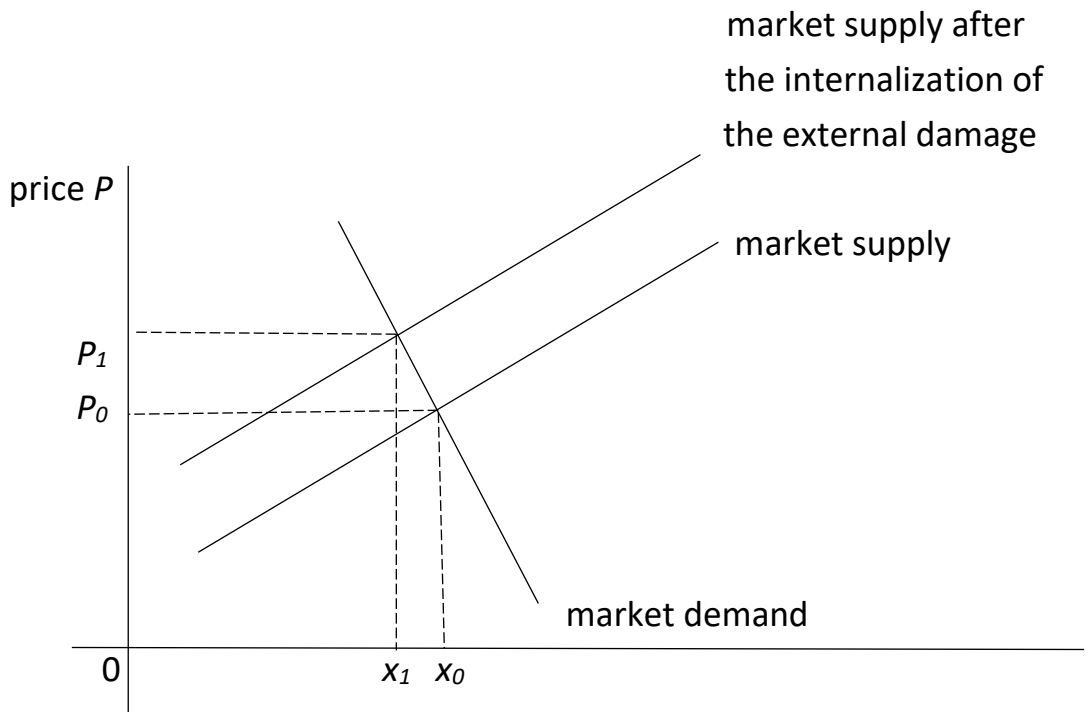
Pollution (including the emission of carbon dioxide into the atmosphere) is the clearest example of a negative externality. As waste and by-product from production activities, CO_2 emissions lead to global warming which in turn causes considerable economic (and non-economic) damage, presently and in the future. Factories may emit carbon and cause (climate) damage, but they are not paying for these damages, because the (global warming) cost of carbon is not (fully) included in the market-based system of costs and prices. Pollution exists because it is the cheapest way of doing things for the firm and the consumer – but not for those who carry the real (tangible) cost of carbon emissions.

The external (pollution) costs are not included in the total cost function of firms and hence do not feature in their marginal-cost functions. This is illustrated in Figure 8. The original market-supply curve in Figure 8 is based on the (marginal) cost of production. The market-supply curve reflects the willingness and ability

of profit-maximizing firms to cater to market demand. At price P_0, firms are willing to supply the quantity of goods x_0. Price P_0 happens to be the equilibrium price, because at this price buyers are demanding quantity x_0. Price P_0 is based on the (marginal) costs of production but these do not include the external (pollution) costs.

Whatever is cheap or free will be over-consumed or over-used – and hence, as long as the external damage of CO_2 emissions is not fully internalized into total cost and marginal cost, the economic system will over-produce carbon-intensive goods and services. This is shown in Figure 8. Suppose we find ways (such as a carbon tax) to force firms to internalize the external (pollution) costs in their costs, prices and decision-making. Including the external cost leads to an upward shift of the market-supply curve – the price needed to cover the (marginal) production cost of output x_0 is P_1 (rather than P_0). If the pollution cost is charged and the price is P_1, buyers will demand x_1 (instead of x_0). Production and consumption will be lower and the cost of pollution is covered; the sufferers from the negative (pollution) externality can – in principle – be compensated for the damage they suffer. We will come back to this issue (how to internalize the externality cost of CO_2 emissions in costs and prices) later in this course.

Figure 8



5. Public goods (including knowledge)

A final category of market failure arises when the market mechanism cannot allocate at all, because the good in question is not produced by (profit-seeking) private firms. These goods are called public goods. Goods or services bestow collective benefits on members, while generally no one can be excluded from enjoying their benefits, not just those who pay for them (once the good is produced, no one can be excluded from consuming it). Public goods never enter the market system in the first place, so it is not surprising that the market cannot allocate them. We call these goods public goods (to distinguish them from ordinary 'private' goods, produced by private firms and allocated through the market). A pure public good has two peculiar characteristics:

- non-exclusivity: a public good is 'non-excusive', which means that no one can be excluded from consuming the good, once it has been produced – including consumers who do not pay for the good. I can deny you the use of my mobile phone. There is no way of denying you the use of 'my' lighthouse, 'my' clean (unpolluted) air, 'my' national defense system, or 'my' (Dutch) dikes (which provide us with protection from the sea and rivers).
- non-rivalry: a public good is 'non-rival', meaning that the consumption of a public good by one extra user does not require additional scare resources and/or does not interfere with its consumption by other users. A lighthouse is as effective for ten boats as for one. A weather services is as useful for 1 million radio listeners as for 100. By way of contrast, private goods cannot be consumed in the same way: food, clothing, electronics etc that I use cannot be also consumed by you.

Not all public goods are entirely pure (i.e. they may feature only one of the two characteristics). However, all public goods share a common difficulty: their provision cannot be entrusted to private initiative, because consumers will not buy the good themselves but rather thy to enjoy the goods someone else buys. This is called free-riding and it is possible because non-paying consumers cannot (easily) be excluded from consuming the good. As a result of the free-riding, firms will be unable to recoup their production cost, because most users will not be paying. Demand for this good may be high, but firms will refrain from

producing and supplying the public good, since the suppliers of a public good will not be able to appropriate all the benefits the goods offers. Because others cannot be excluded from benefiting from the good and since others can use the good at no cost, society's benefits from the public good will exceed the benefits that accrue to any single buyer.

Public goods thus escape the market and cause free riding. Left to private initiative, the supply of public goods – such as roads, law courts, education, basic health care – would be far lower than what we (as society) actually would want. Private markets will under-allocate resources to the production of public goods.

How do we then determine the level of provision of public goods? We do this by eschewing the market mechanism and using another way to organise the collective action required to produce the public good: voting. We vote for the amount of public goods we want (as a society).

Knowledge is widely argued to be an important public good. Knowledge is non-exclusive: once it has been generated, one cannot keep other people from using it – unless one introduces strict intellectual property rights (IPRs), such as patents, which de facto turn knowledge into a private good. Knowledge is also non-rival: a lecture is as effective for 100 students as for 5, and the fact that you have 'digested' this lecture note does not prevent other students from learning from it as well.

Exercises and questions

Exercise 1

In a market of perfect competition, aggregate market demand for good XYZ is given by: $Q^D = 400 - 3 \times P$. Aggregate market supply is given by the following equation: $Q^S = 100 + 2 \times P$. All firms in this market are identical and work with the following total cost function: $TC_i = 278 + 12 \times Q_i + 2 \times (Q_i)^2$, where *i* is the *i*-th firm. Output *Qi* is measured in 1000 units. Consider the following two propositions concerning this market of perfect competition.

Proposition I: The profit-maximizing level of output of each firm is 3000.

Proposition II: There will be no entry into this market, because $P < AC_i$.

Which one of the following statements is true?

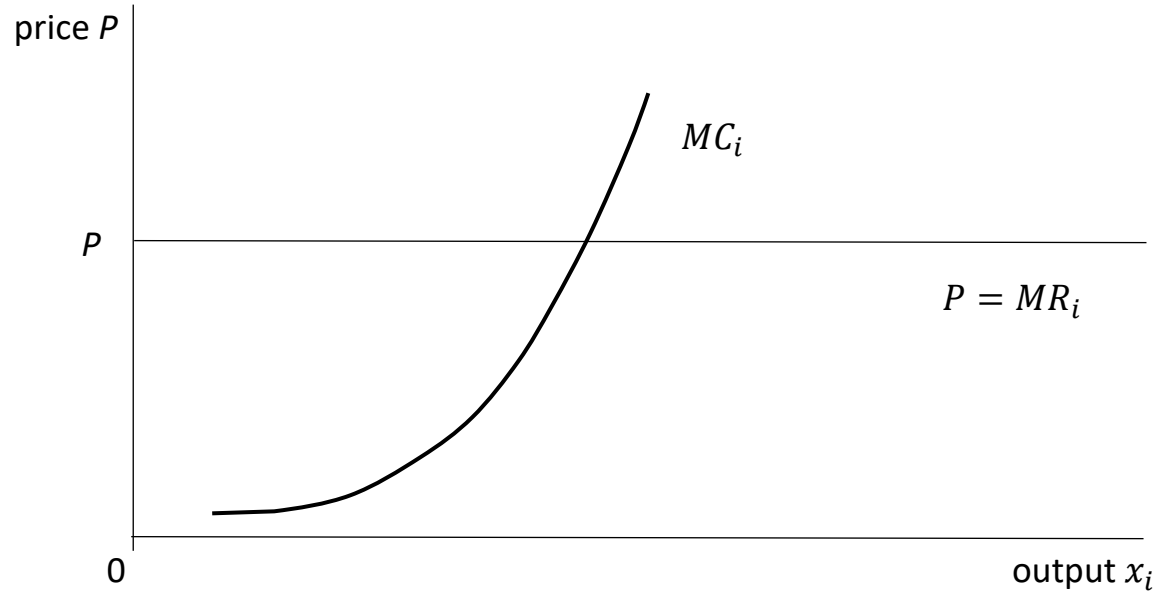
a. Both proposition I and proposition II are true.
b. Both proposition I and proposition II are false.
c. Proposition I is true and proposition II is false.
d. Proposition I is false and proposition II is true.

Exercise 2

In the highly competitive flash-drive industry, a new innovation makes it possible to cut the average cost of an 64-gigabyte flash drive, small enough to fit into your pocket, from €5 to €4. In the long run, what will the price of an 64-gigabyte flash drive be?

Exercise 3

Consider the following figure for a competitive industry:

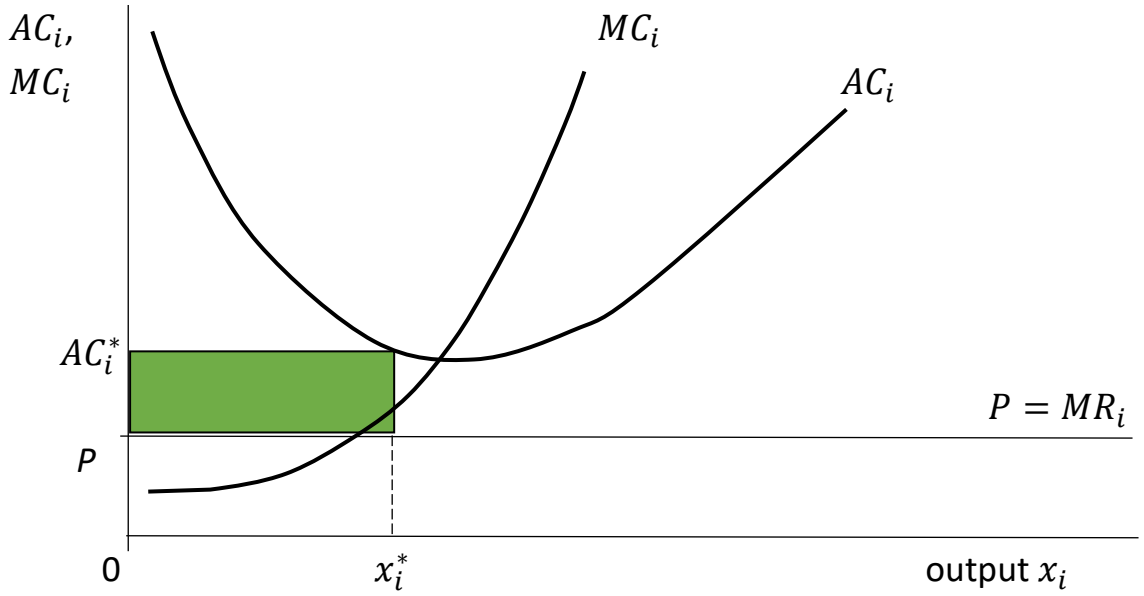


Suppose firm i decides to increase the wages of its employees – in all other firms, wages remain unchanged.

a. What happens to the marginal cost curve of firm *i*? Illustrate this in the figure.
b. What will happen to the profit-maximizing level of output of firm *i*?
c. What will (likely) happen to the number of jobs in firm *i*? Explain your answer.

Exercise 4

Consider the following figure for a firm in perfect competition:



a. Explain the meaning of the green rectangular area in the figure. Why is the equilibrium position in the figure a short-run equilibrium?
b. Explain what will happen in this market in the long run. Illustrate this in the figure.

Questions

1. Which are the two tasks for any mechanism of social coordination?
2. Explain the structure-conduct-performance approach.
3. Highlight five key assumptions underlying the theory of perfect competition.
4. What is the difference between the short-run equilibrium and the long-run equilibrium in perfect competition?
5. In which ways does perfect competition produce 'desirable' outcomes? For whom?
6. Discuss three limitations of the theory of perfect competition.
7. What is the problem of asymmetric information? Why does it lead to market failure?
8. Why are markets unstable? Use the cobweb mechanism in your answer.
9. What are externalities? Why does a (negative) externality lead to market failure?
10. What are public goods? Use the two defining characteristics in your answer.
11. Explain why public goods will not be produced by private firms. Use the notion of free-riding in your answer.
12. Why do economists consider knowledge a public good? Do you agree?

The answers to the questions can be found in this lecture note 😊.

Answers to the exercises

Exercise 1.

Answer B. Proposition I = false; Proposition II = false.

First, we calculate the equilibrium price in the aggregate market as follows:

$Q^D = 400 - 3 \times P \; = \; Q^S = 100 + 2 \times P$ (demand = supply)

This gives: 400 – 3P = 100 + 2P → 5P = 300 → P =60 → MR = 60 (marginal revenue of each firm). Next, we derive marginal cost by differentiation the total cost function with respect to output Qi. This gives: MCi = 12 + 4Qi

The condition for profit maximization is Marginal Revenue = Marginal Cost, or:

MCi = 12 + 4Qi = MR = P = 60 → 4Qi = 48 → Qi = 12 → TR = 720 → TC = 710

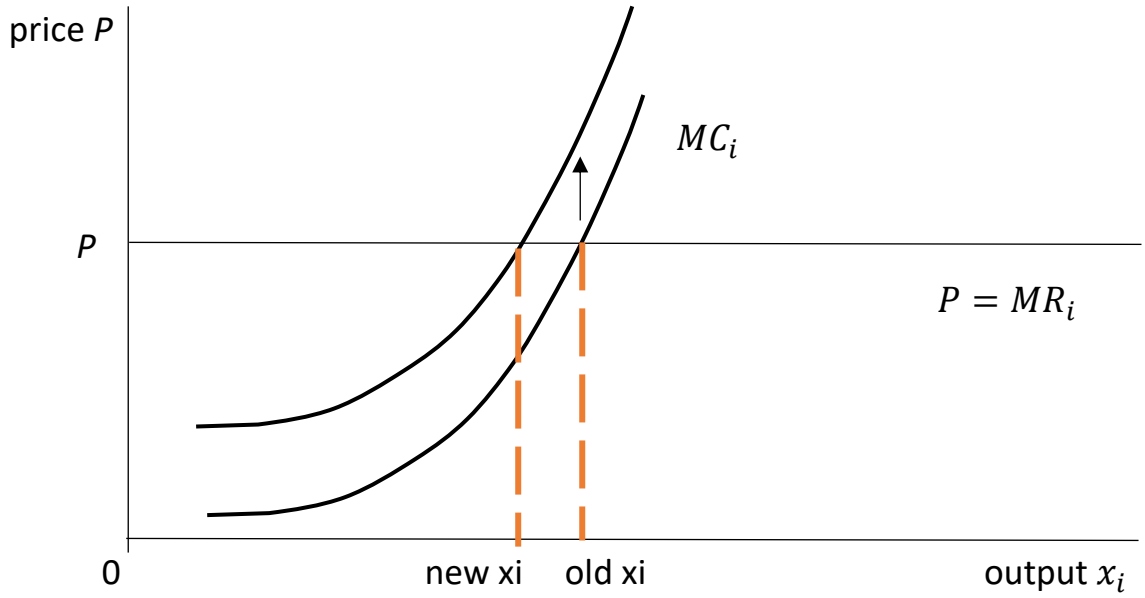
→ Profits = 10 The profit-maximizing level of output is 12000.

Average cost = TC/Qi = 710/12 = 59.2 Hence ACi < P because P = 60.

Exercise 2.

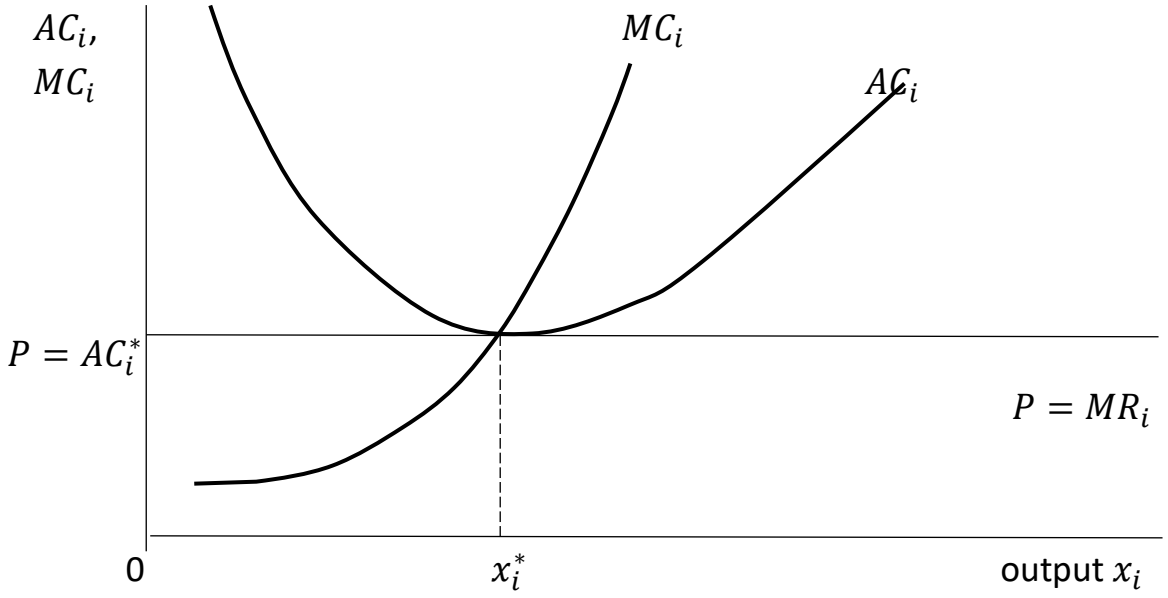
In the long run, (perfect) competition will drive down P to the level of AC. Hence, in the long run the price will be €4. Firms will make super-normal profits only temporarily. The benefit of the lowered production cost will accrue to buyers in the long run.

Exercise 3.



a. The MC-curve will shift up due to the increase in wages. (Wages are part of variable cost and hence affect marginal cost). Due to the higher wages, each additional unit of output becomes more costly to produce.
b. Profits are maximum if MR = P = MC. In order to maximize profits (based on the new MC-curve), firm *i* will reduce its output (from old xi to new xi).
c. Most likely the number of jobs will be reduced, as output is lowered. In this model, the higher wages lead to a loss of employment in firm *i*.

Exercise 4.



a. In this market, each firm is making a loss at the initial market price P. The green rectangular area is the size of the negative profit (loss) of firm *i*. It arises from the fact that the equilibrium market price P < ACi. There are too many sellers in this market. This is a short-run outcome, because it cannot last: firms cannot survive if they have permanent negative profits.
b. The adjustment happens through firm that exit the market. Due to firms' exiting, the market-supply curve will shift to the left. The equilibrium market price will rise. This adjustment process will continue until P = MCi = ACi - which is the long-run equilibrium in perfect competition illustrated in the figure.