Applied Microeconomics: Firm and Household

Lecture 13: Partial Equilibrium

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Outline

- Market Demand
- Market Supply in the very short run
- Perfect Competition
  - Short-Run Equilibrium
    - Comparative statics of short-run equilibrium (shifts in demand and supply)
  - Long-Run Equilibrium
- Long-Run Supply Curves
- Producer Surplus, Welfare, and Economic Efficiency

Market demand

Suppose an individual spends her income, I, on two goods, x and y. Her demand for x is denoted as

- Quantity of x demanded = $x(p_x, p_y, I)$

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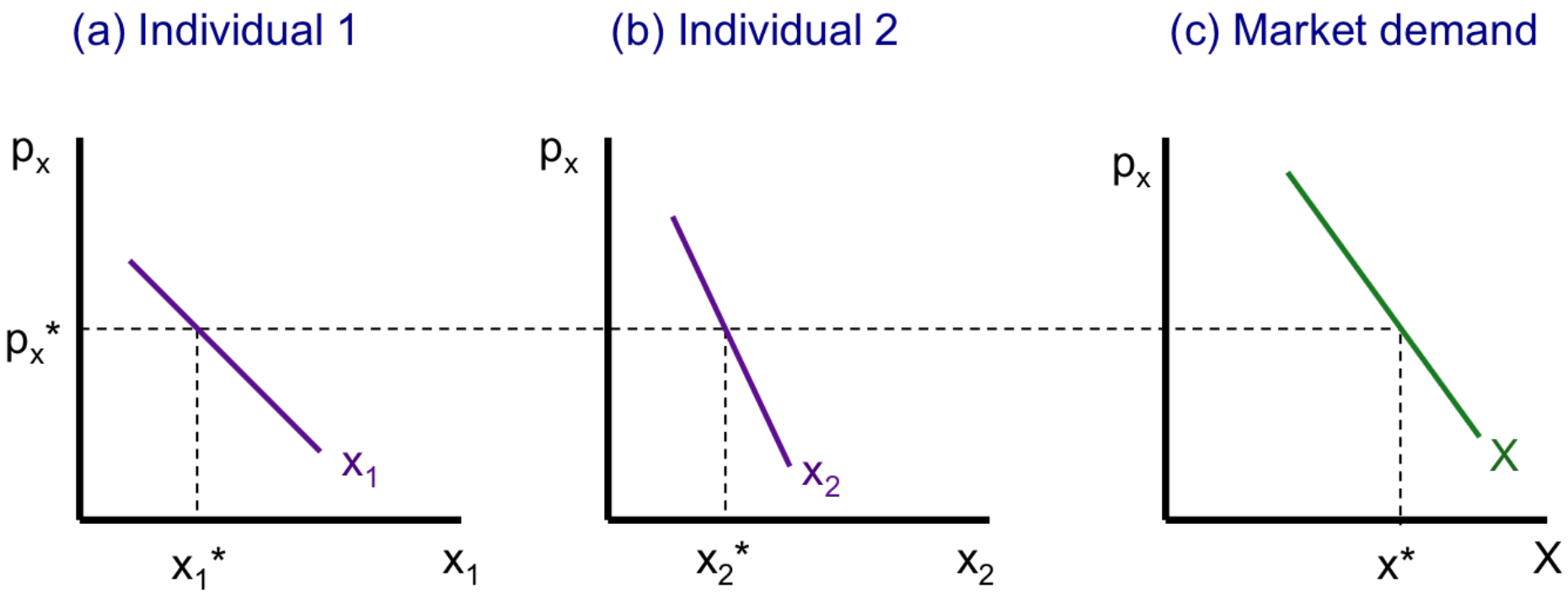
Definition: The market demand function for X is the sum of each individual's demand for x. Formally,

- $X(p_x, p_y, I) = \sum_i^M x_i(p_x, p_y, I_i)$

where subscript i reflects each individual in the market.

- If all individual demand functions are downward-sloping, the market demand function is also downward-sloping.

Deriving the market demand curve



- A market demand curve is the “horizontal sum” of each individual’s demand curve.

Shifts in market demand curve

- The market demand curve summarizes the *ceteris paribus* relationship between x and p_x.
  - Other determinants of demand such as p_y and the income of each individual are held constant.
- The market demand curve for x shows how the quantity of x demanded changes as p_x changes. This corresponds to a movement along the demand curve (a **change in quantity demanded**).
- Changes in other determinants of the demand for x cause the demand curve to shift to a new position (a **change in demand**).

Elasticities of market demand

- Own-price elasticity of demand
  - Sometimes just “price elasticity of demand”
  - $\epsilon_{Q,p} = \frac{\partial Q_D(p,p',I)}{\partial p} \frac{p}{Q_d}$
  - $\epsilon_{Q,p}$ measures percentage change in the quantity demanded in response to a one-percent change in the good’s price.
  - if $\epsilon_{Q,p} \begin{cases} < -1 & \text{demand is elastic;} \\ (-1, 0) & \text{demand is inelastic.} \end{cases}$

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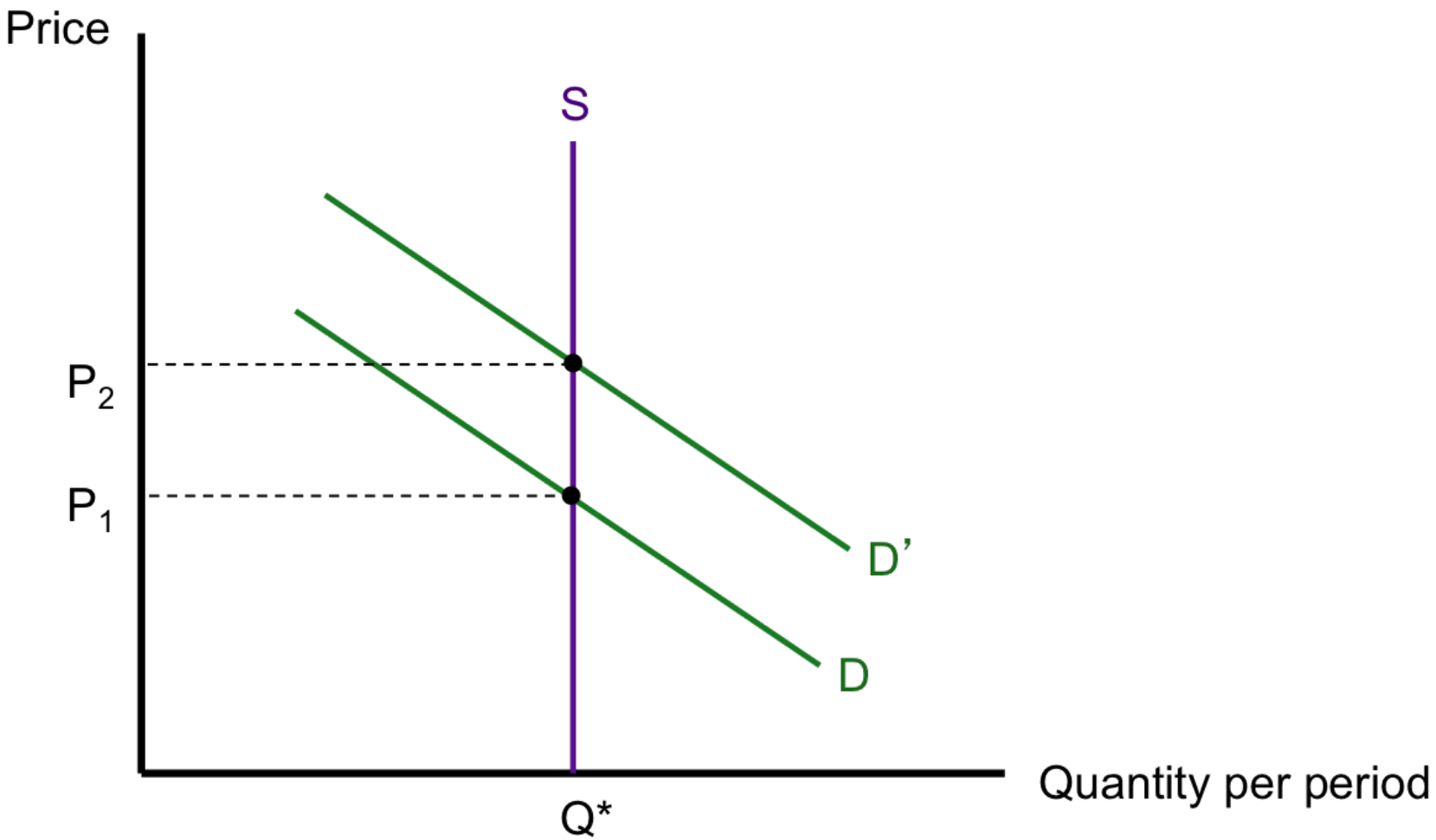
- Income elasticity of demand
  - $\epsilon_{Q,I} = \frac{\partial Q_D(p,p',I)}{\partial I} \frac{I}{Q_d}$
  - $\epsilon_{Q,I}$ measures percentage change in the quantity demanded in response to a one-percent change in income.

Pricing in the very short run

In the very short run there is no supply response to changing market conditions

- Typically there is a lag between changing market conditions and a firm's response because most decisions cannot be implemented instantaneously, e.g., increasing capacity, increasing labor.
  - Price will adjust to clear the market
  - Price acts only as a device to ration demand
  - The supply curve is a vertical line at the prevailing market quantity
- This very-short run analysis is not very empirically useful

Pricing in the very short run



Pricing in the very short run: Durable or storable products

The producers of durable or storable products can respond to demand changes without changing their production

- For example, total amount of agricultural commodity is fixed at the harvest.
- However, farmers can change market supply by changing their inventories.

Question: Is the supply curve vertical in this case?

Perfect competition

The **perfect competition** model is our workhorse model of how markets behave.

- It imposes many strong assumptions
- These assumptions are frequently unrealistic or unreasonable
- However, perfect competition:
  - is highly *tractable*
  - provides a good empirical fit for reality in many situations
  - is a useful benchmark for comparing other, more sophisticated models

Assumptions of the perfect competition model

The main assumptions of perfect competition are:

- Products are homogeneous and perfectly divisible.
  - Products are identical and fractional products can be traded in the market.
- All buyers and sellers have perfect information.
- There are no transaction costs.
- Both buyers and sellers are price takers.
  - Price is determined by the market. An individual agent cannot influence the price.
  - i.e. price enters the optimization problem as a parameter, *not* a choice variable
- There are no externalities.
  - Each firm bears full costs of its production.
- There are no barriers to entry.

Perfect competition

- The strong assumptions of perfect competition apply to only a few markets.
- But, because of its desirable properties, such as efficiency, the perfect competition model provides an ideal against which we compare other market structures.
- As we study the models of imperfect competition, such as monopoly and oligopoly, we will analyze i) how these markets deviate from perfectly competitive outcome and ii) what the economic implications of those deviations are.

Perfect competition: Important outcomes

Even though the price-taking assumption is typically listed among the *assumptions* of perfect competition, it is in fact an *outcome* of other assumptions. Namely, homogeneity of products, perfect information, and zero transaction costs.

Perfect competition: Important outcomes

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In the following, we are going to analyze the two important equilibrium outcomes of perfect competition:

- In the short run, equilibrium output is at a level where the market price equals the marginal cost of production, $p = MC$.
  - Also, firms can make positive profits in the short run.
- In the long run, equilibrium output is *also* at a level where market price equals the minimum of average cost, AC^*, (due to no barriers to entry). Firms make zero profits in the long run.

Main distinction: In the SR the number of firms in a market is fixed. In the LR firms can enter & exit instantaneously.

Perfect competition: The behavior of a single firm

Because price is determined by the market, in perfect competition a firm decides how much to produce. The profit maximization problem of a firm is:

- $\max_q \ \pi = pq - C(q)$

where p is price, q is the quantity the firm produces, and C(q) is total cost.

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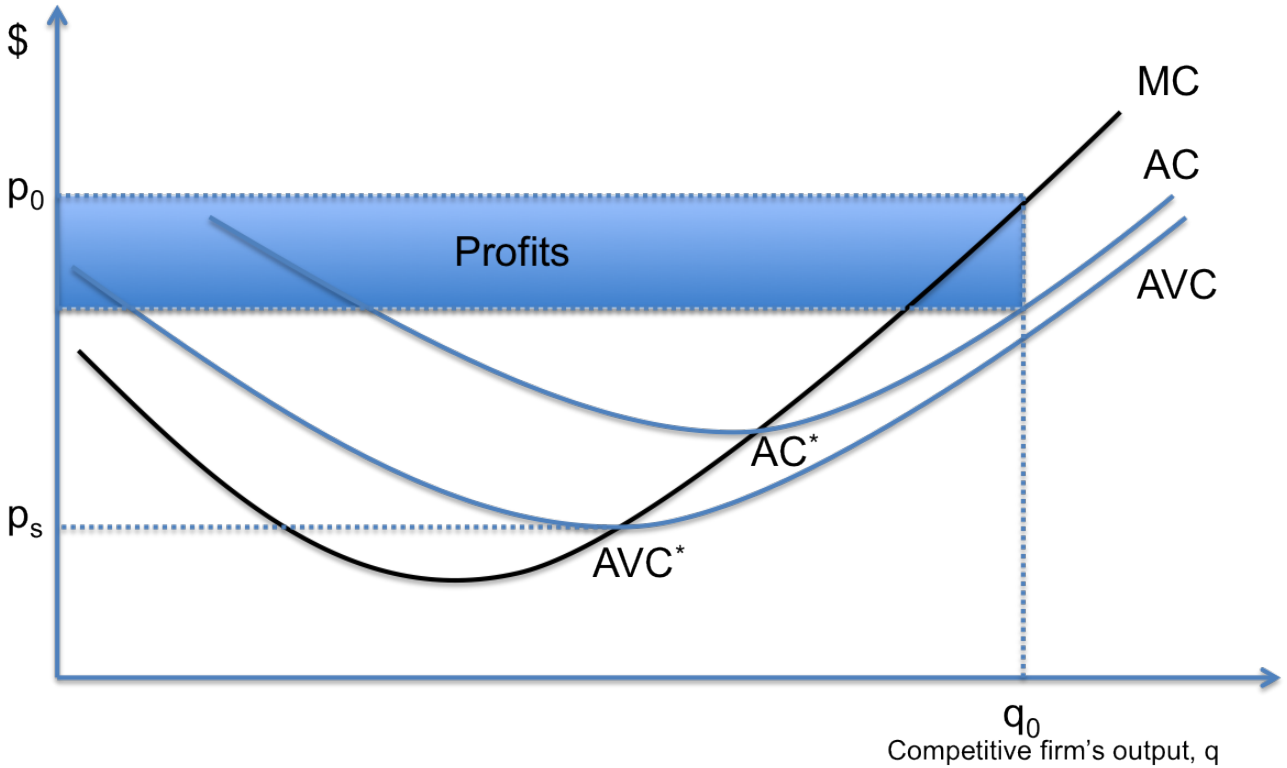
The FOC of this problem is:

- $\frac{\partial \pi}{\partial q} = p - \underbrace{\frac{\partial C(q)}{\partial q}}_{MC(q)} = 0$
- $p = MC(q)$

Under perfect competition a profit-maximizing firm produces at a level where the cost of producing the last unit of output is equal to the market price.

Cost curves and profit maximization



- At market price p_0 the firm produces q_0 units of output.
- At q_0 units of output firm makes $(p_0 - AC(q_0))q_0$ profit, (the shaded area).

Shutdown/Short-run market exit

The shutdown decision critically depends on whether fixed costs are sunk or avoidable.

If all fixed costs are sunk, the firm shuts down if the market price is below the minimum average variable cost, AVC^*. In the figure, the shutdown price is denoted as p_S.

- Note that at market prices that are below AC^* but above AVC^* the firm keeps operating. Because the fixed costs are sunk, there is no need to worry about them. It is profitable to produce and earn some revenue in excess of variable cost, (short run shutdown decision).

On the other hand, if all fixed costs are avoidable, a firm shuts down if market price is below the minimum average cost, AC^*.

- In this case, at prices below AC^* but above AVC^* the firm shuts down. Because it is more profitable to exit the market and recover the fixed costs (= long run shutdown decision).

The firm's short-run supply curve

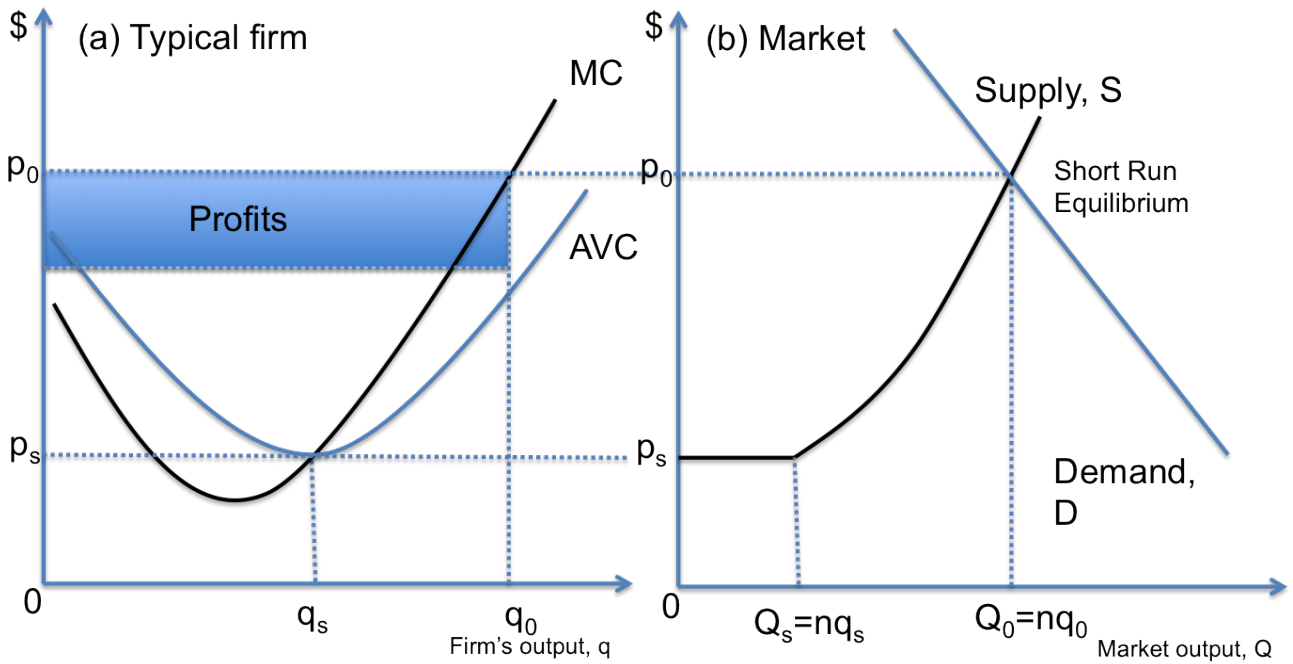
The firm's supply curve reflects the quantity that a firm is willing to supply at any given price.

In the figure, the firm is not willing to supply at prices below p_S. That is, at prices below p_S (the shut down price) the supply is zero.

At prices above p_S, the firm supplies a quantity at which the cost of the last unit of output (MC) is equal to the market price (p). Thus, the firm produces more at higher market prices.

The firm's supply curve is the portion of the MC curve that is above the minimum average variable cost. AVC^*.

Short-run equilibrium



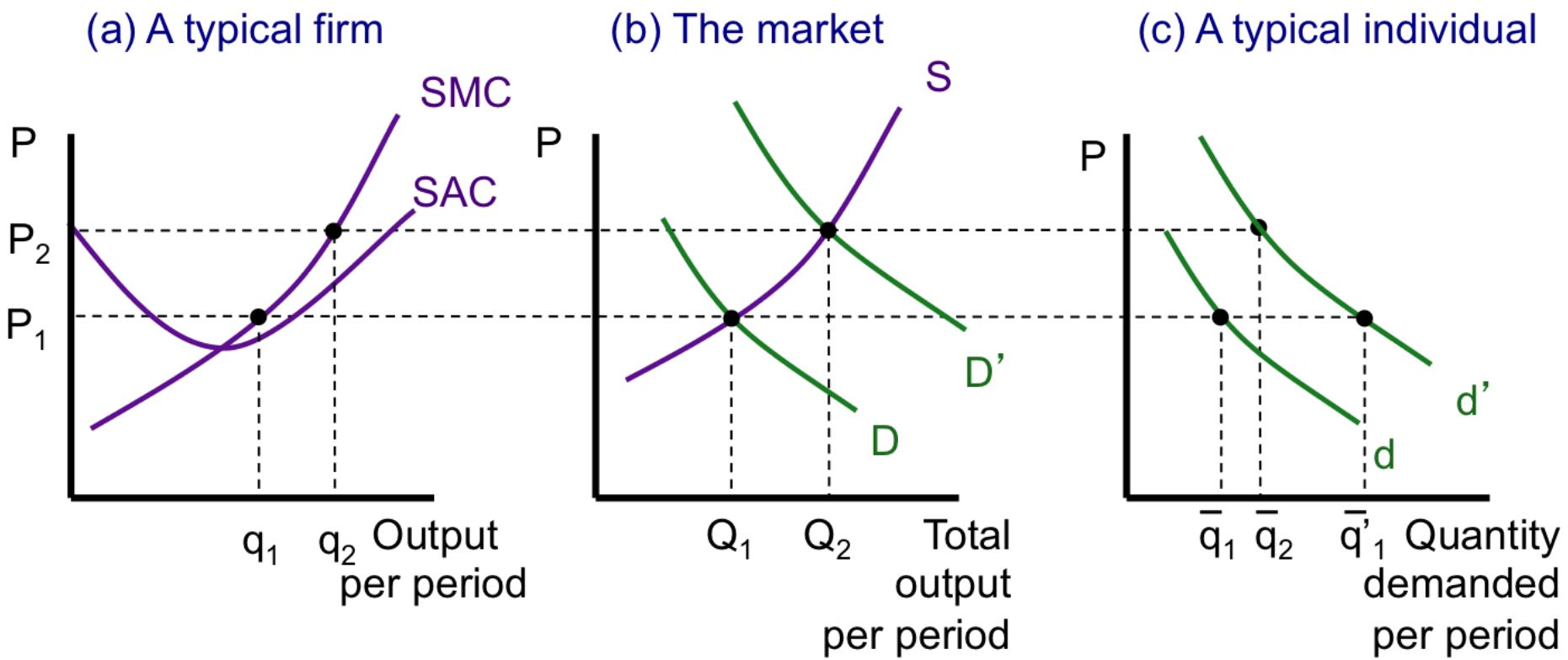
- In the figure it is assumed that there are *n* identical firms. All fixed costs are sunk in the SR.
- The SR market-supply curve is the horizontal sum of the supply curves of each firm.

Short-Run equilibrium

Highlights:

- The market price, p_0, is determined at the intersection of market demand and the SR market supply curve.
- At the market price, the market quantity Q_0, and is equal to the sum of the outputs of all n individual firms, nq_0.
- In the SR, firms can make profits. But in the LR, positive profits will cause firms to enter the market – driving profits down to zero.

Short-run equilibrium: shift in an individual demand



Shifts in supply curves

Supply curves shift if:

- technology changes (e.g. production becomes more efficient)
- Input prices change (e.g. fuel prices change)
- New firms enter the market or incumbent firms exit
- Incumbent firms change their production capacity

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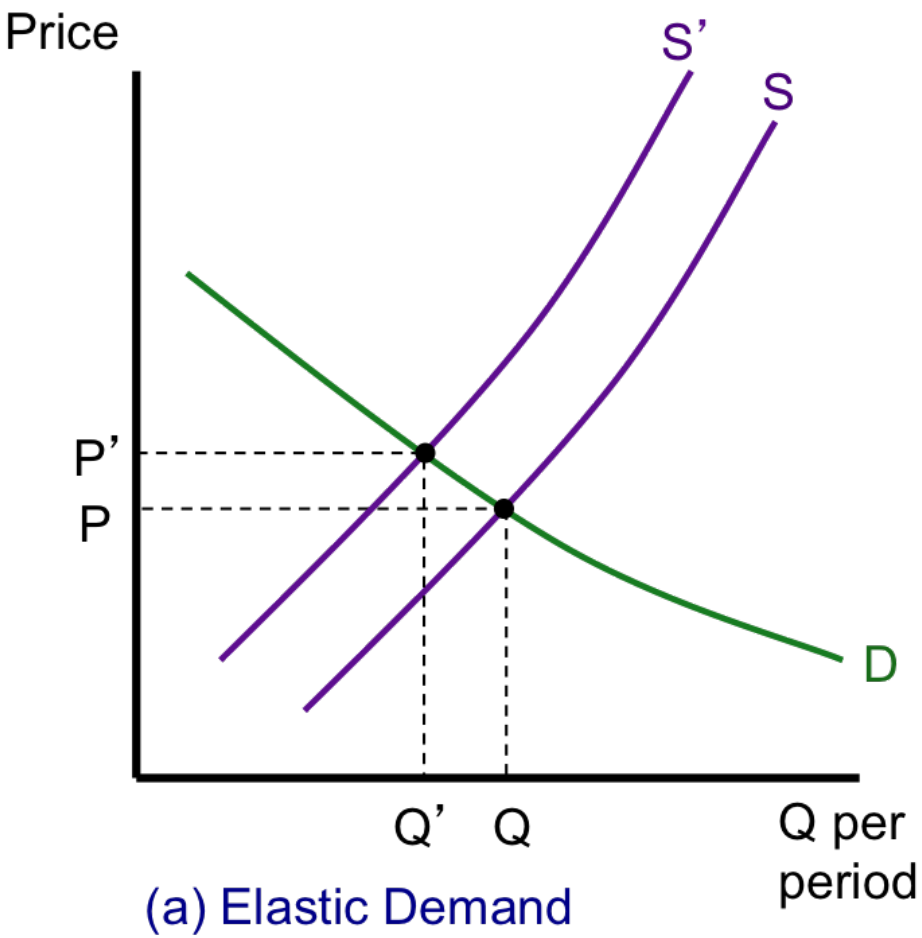
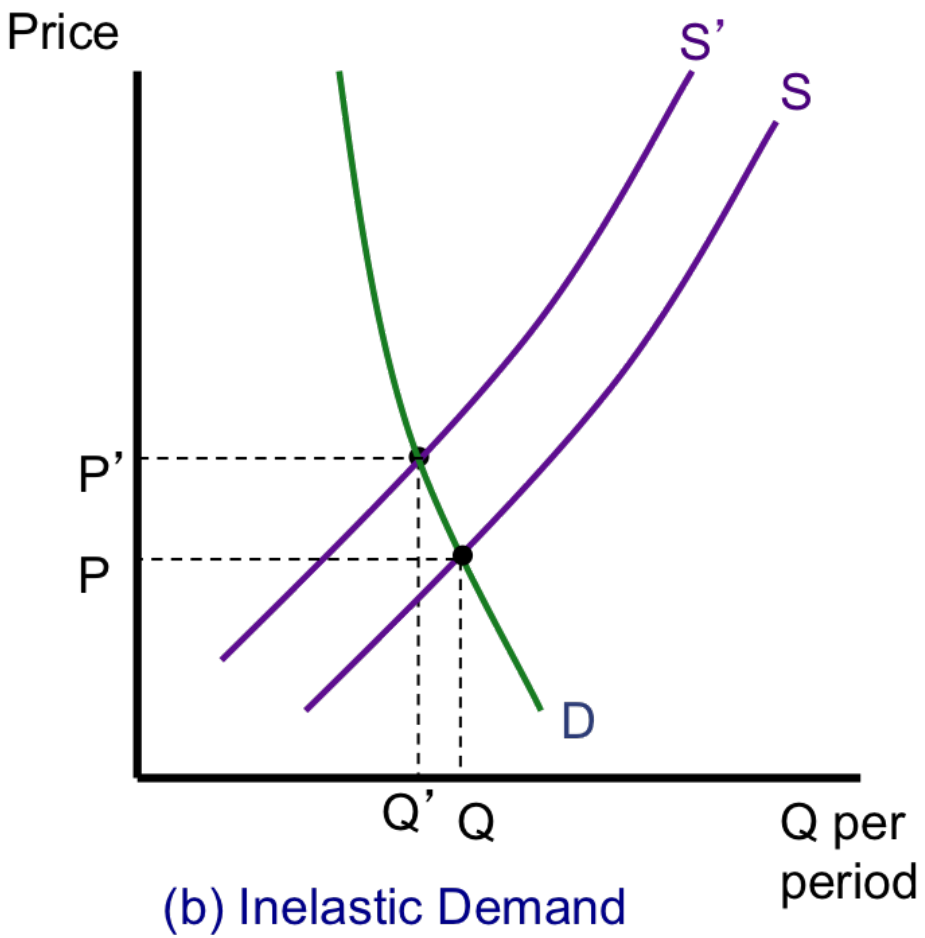
Suppose that due to an increase in oil prices, the production cost of an agricultural commodity increases (i.e. the supply curve shifts upward).

- The extent to which the market price increases depends on the price elasticity of demand
  - If demand is inelastic, the increase in the market price will be larger relative to an elastic demand curve.

Shifts in supply curves





Shifts in demand curves

Demand curves shift if:

- Preferences change (e.g. consumers become more health aware)
- Prices of substitutes and complements change
- Incomes change
- Consumers enter or exit the market (e.g. demographic changes like births, deaths, migration, etc.)

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Suppose consumers' income increases (i.e. the demand curve shifts upward).

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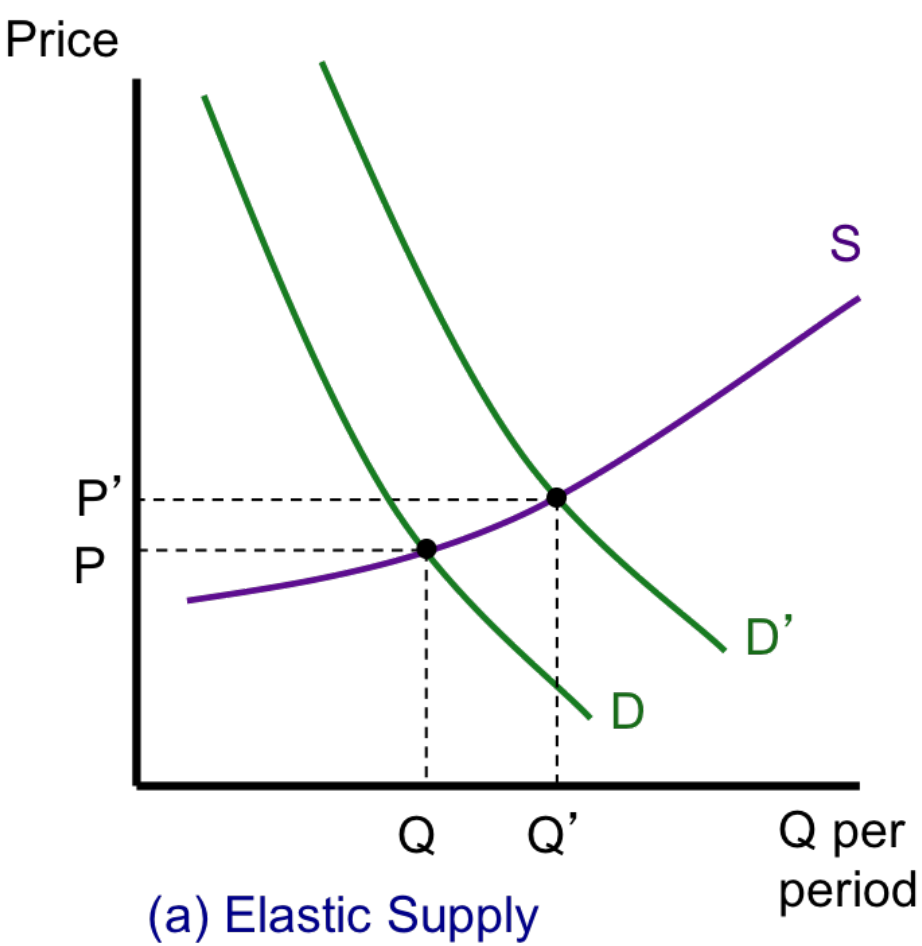
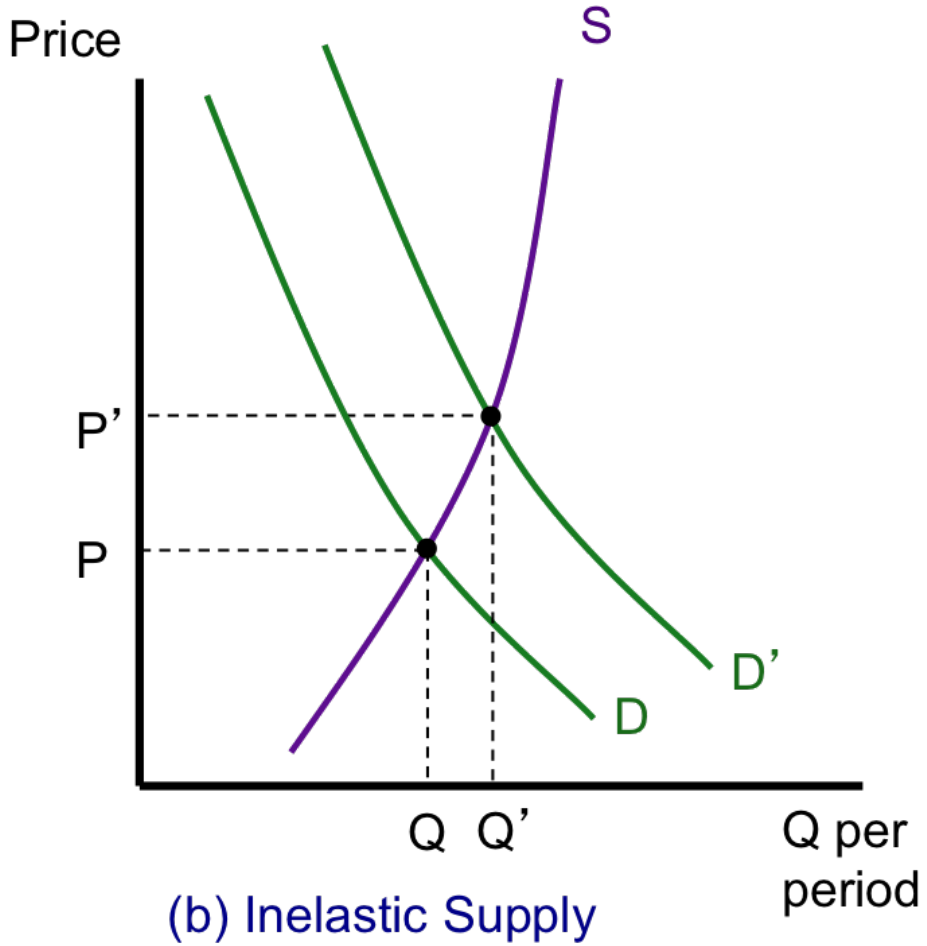
Shifts in demand curves





Comparative statics of market equilibrium

Denote the market demand and supply functions as

- $D(p, \alpha)$ and $S(p, \beta)$

where α and β are demand and supply shifters respectively. The equilibrium condition is

- $D(p, \alpha) = S(p, \beta)$

Suppose we want to know the impact of a demand shifter on market price, i.e., $\frac{\partial p}{\partial \alpha}$. We start by taking the α derivative of demand and supply:

- $\frac{\partial D}{\partial \alpha} = D_p \frac{\partial p}{\partial \alpha} + D_\alpha$
- $\frac{\partial S}{\partial \alpha} = S_p \frac{\partial p}{\partial \alpha}$

Comparative statics of market equilibrium

At the equilibrium $\frac{\partial D}{\partial \alpha} = \frac{\partial S}{\partial \alpha}$ (why?)

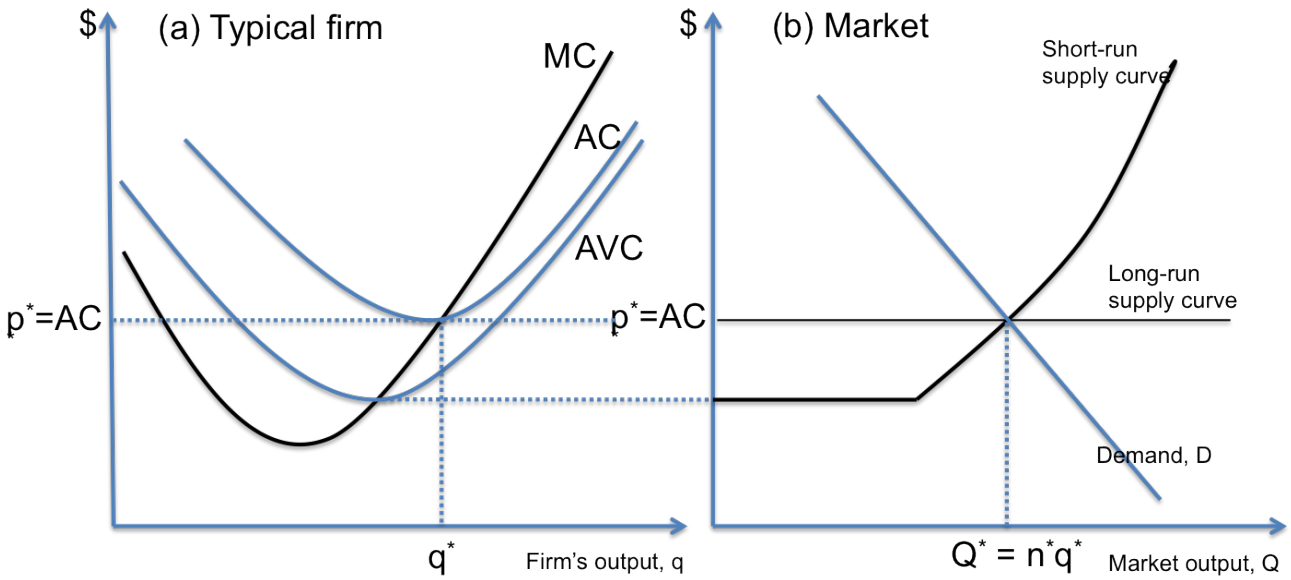
- $D_p \frac{\partial p}{\partial \alpha} + D_\alpha = S_p \frac{\partial p}{\partial \alpha}$
- $\frac{\partial p}{\partial \alpha} = \frac{D_\alpha}{S_p - D_p} \gtrless 0$

we can rewrite the comparative static result in elasticity form as

- $\epsilon_{p,\alpha} = \frac{\epsilon_{D,\alpha}}{\epsilon_{S,p} - \epsilon_{D,p}}$

That is, the proportional response of the market price to a one-percent increase in a demand shifter (e.g. income) is equal to the proportional change in demand weighted by the summation of the price elasticities of demand and supply.

Long-Run equilibrium



- In the LR, firms can adjust their capital and enter the market. As firms enter the market, the quantity produced increases – so the market price decreases. This continues until it reaches the minimum average cost, $p^* = AC^*$, so that in the LR firms make zero economic profit.
- In the LR, a firm's entry/exit decision is based on p^*. If the market price is below p^* firms exit (or do not enter).

Long-Run equilibrium

Highlights:

- If the number of firms is very large, the LR supply curve is horizontal at the minimum of the average total cost curve.
- The equilibrium market quantity Q^* is determined by the intersection of the LR supply curve and market demand.
- The LR equilibrium also corresponds to the SR equilibrium, (the demand curve intersects both the LR supply curve and the new SR supply curve at the same point.)
- The output of each firm q^*, hence the equilibrium number of firms n^*, is determined by the intersection of the LR market price, p^* and the SR marginal cost.

Long-run supply curve

The long-run supply curve is determined by the zero-profit condition

- Horizontal - if average costs are constant as firms enter
- Upward sloping - if average costs rise as firms enter
  - Prices of scarce inputs may rise
  - New firms may impose external costs on existing firms
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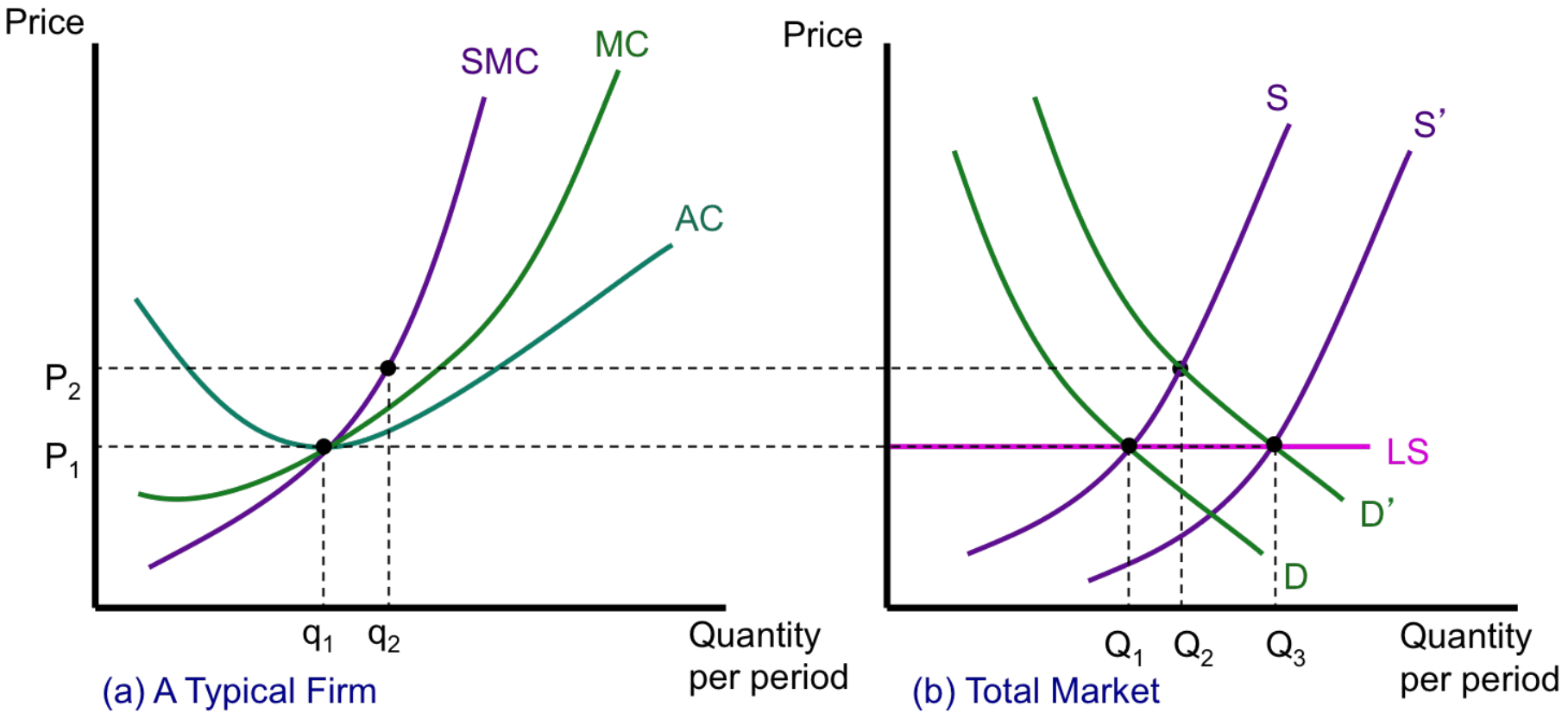
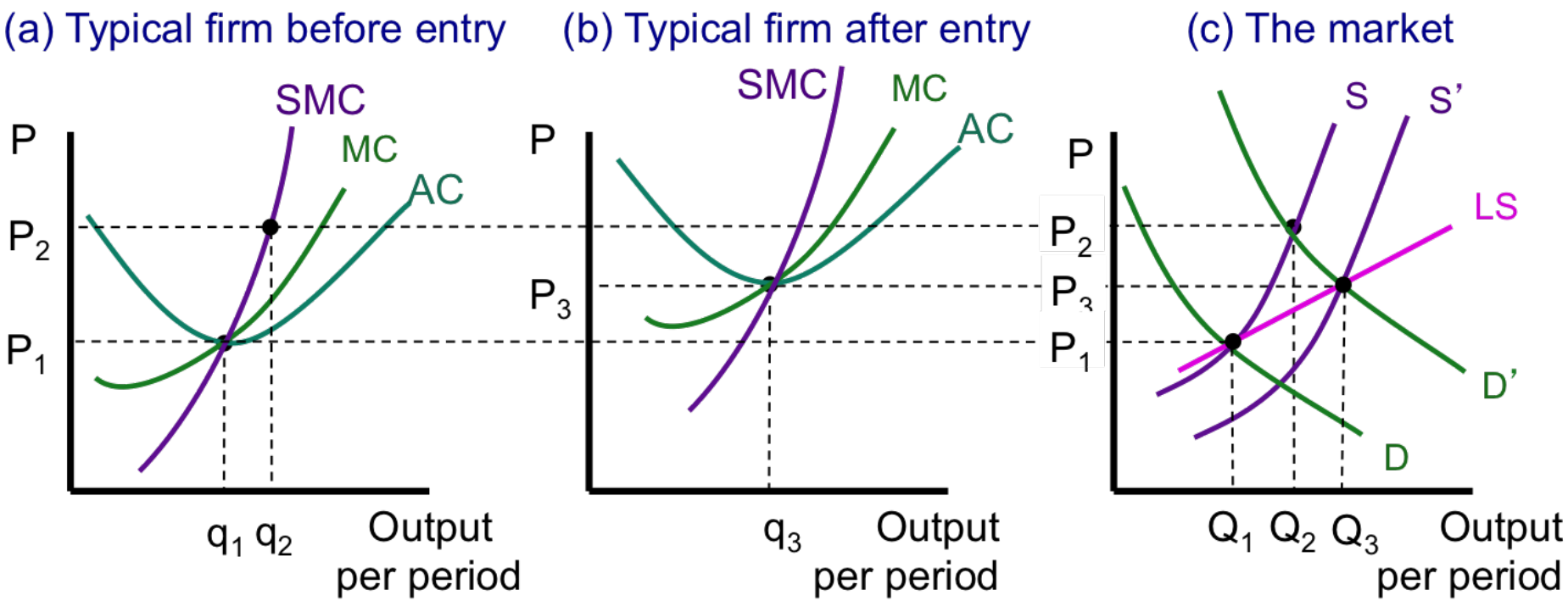
- Downward sloping - if average costs fall as firms enter
  - New firms may attract a larger pool of trained labor
  - Entry of new firms may provide a “critical mass” of industrialization

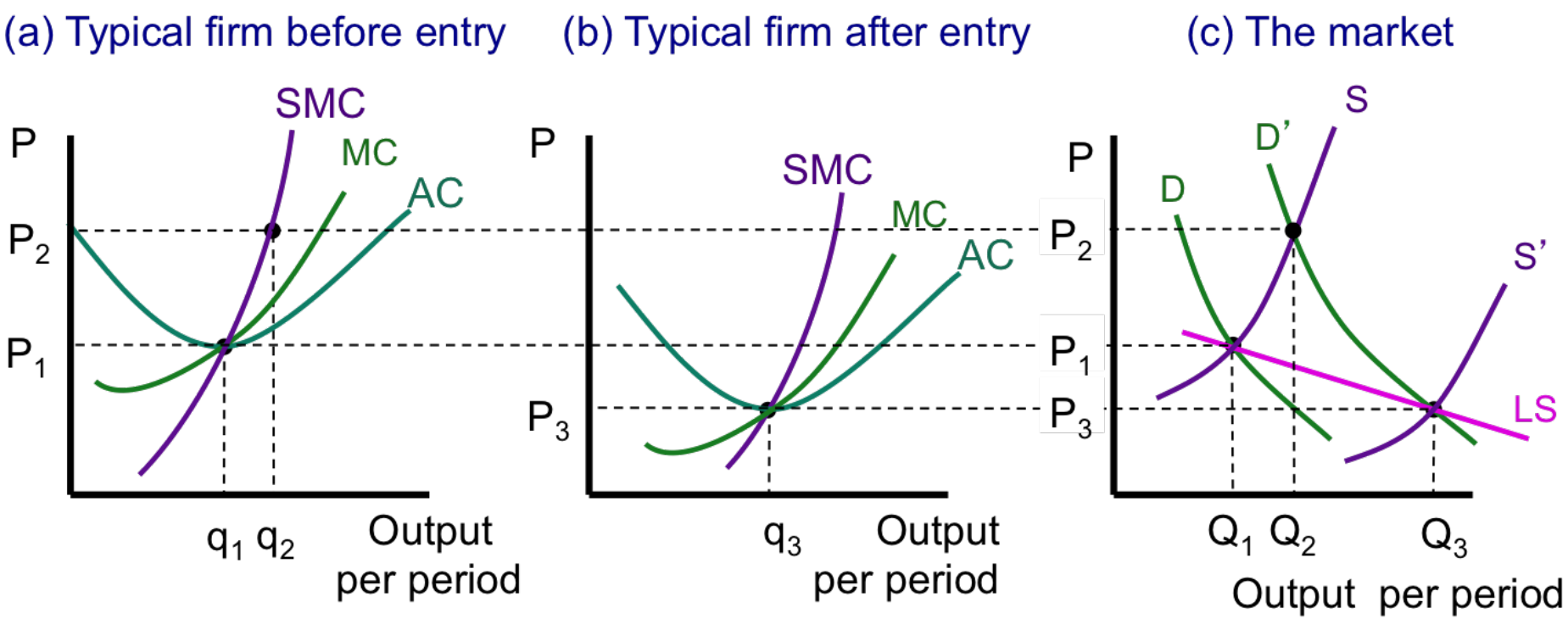
Long run equilibrium: constant-cost industry



Long run equilibrium: increasing-cost industry



Long run equilibrium: decreasing-cost industry



Shifts in Demand

Q: How does a demand shift affect the equilibrium number of firms in a constant-cost industry in the long run?

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Suppose the demand shift changes the industry quantity from Q_0 to Q_1 in the long-run. At the new equilibrium, the change in number of firms is

- $n_1 - n_0 = \frac{Q_1 - Q_0}{q^*}$

where q^* is the output level at the minimum of long run AC.

The change in the equilibrium number of firms is solely determined by the demand shift

- A positive shift increases the number of firms in the industry
- A negative shift decreases the number of firms in the industry

Shifts in Demand

Q: How do changes in input costs, w, affect the equilibrium number of firms in the long-run?

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A change in w:

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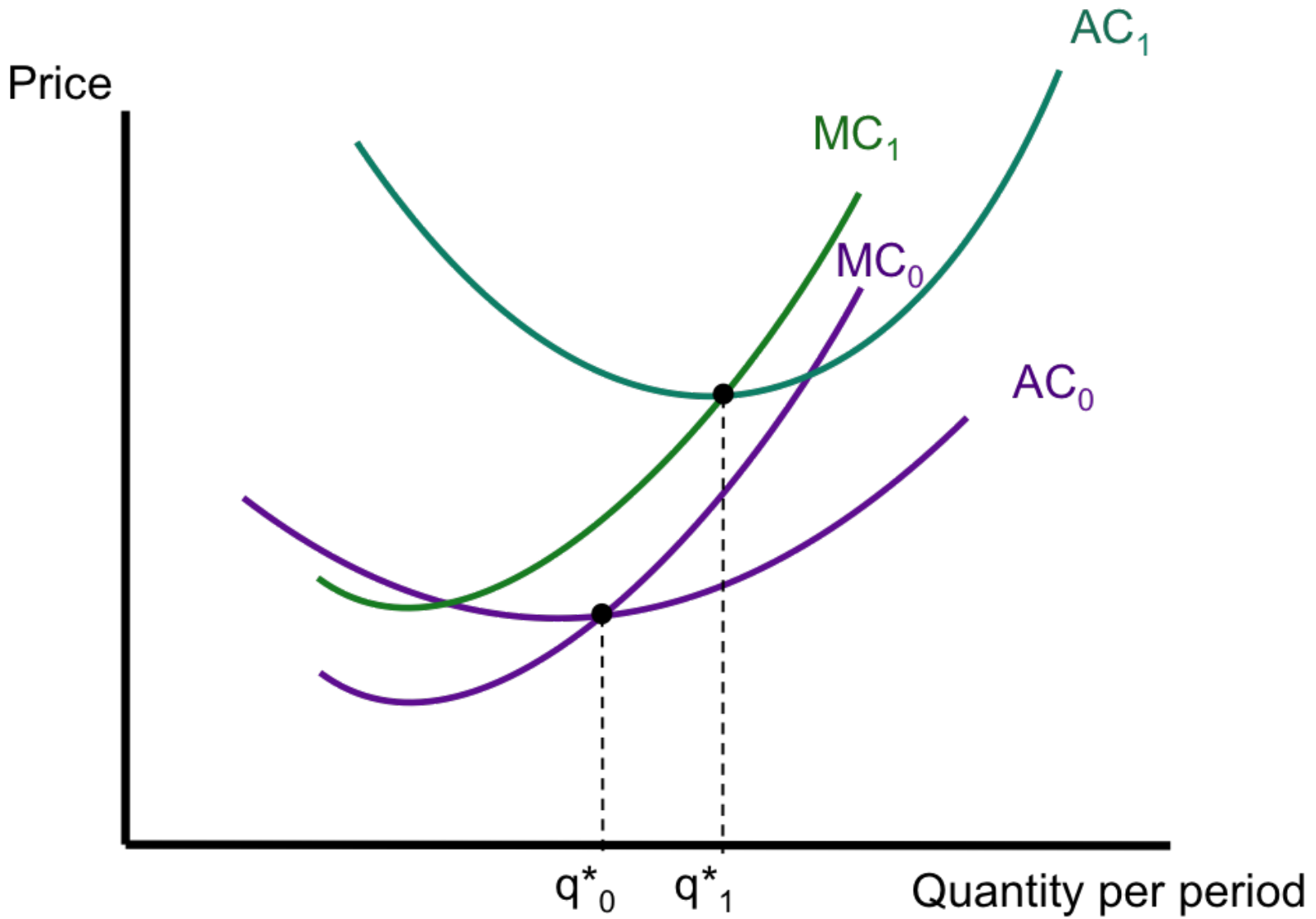
Formally, a change in the number of firms is

- $n_1 - n_0 = \frac{Q_1}{q_1^*} - \frac{Q_0}{q_0^*}$

An increase in w increases the market price p, therefore $Q_1 < Q_0$.

- if $q_1^* > q_0^*$ the number of firms decreases
- if $q_1^* < q_0^*$ the change in the number of firms is ambiguous.

Changes in input costs



Producer surplus

Producer Surplus:

- is the extra return producers make by making transactions at the market price, over and above what they would earn if nothing were produced
- is the area above supply curve and below the market price

In the short run, producer surplus is the sum of short-run profits and fixed costs.

In the long run, firms make zero profits and there are no fixed costs.

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Q: In real-world markets we observe that profitability substantially varies across firms within an industry.

- Delta vs. Southwest, Sam Adams vs. Summit, Coke vs. Pepsi.

What could be the main factors driving this variation?

Producer surplus

If firms differ in their costs (i.e. if there are low-cost firms and high-cost firms), then low-cost firms will earn positive profits in the long run.

- Only the *marginal* firm earns zero profits in the LR (why?)
- Long-run profits for the low-cost firms may be reflected in the prices of the unique resources owned by those firms
  - The more fertile land is, the higher its price
  - Scarcity of low-cost inputs creates the possibility of Ricardian rent

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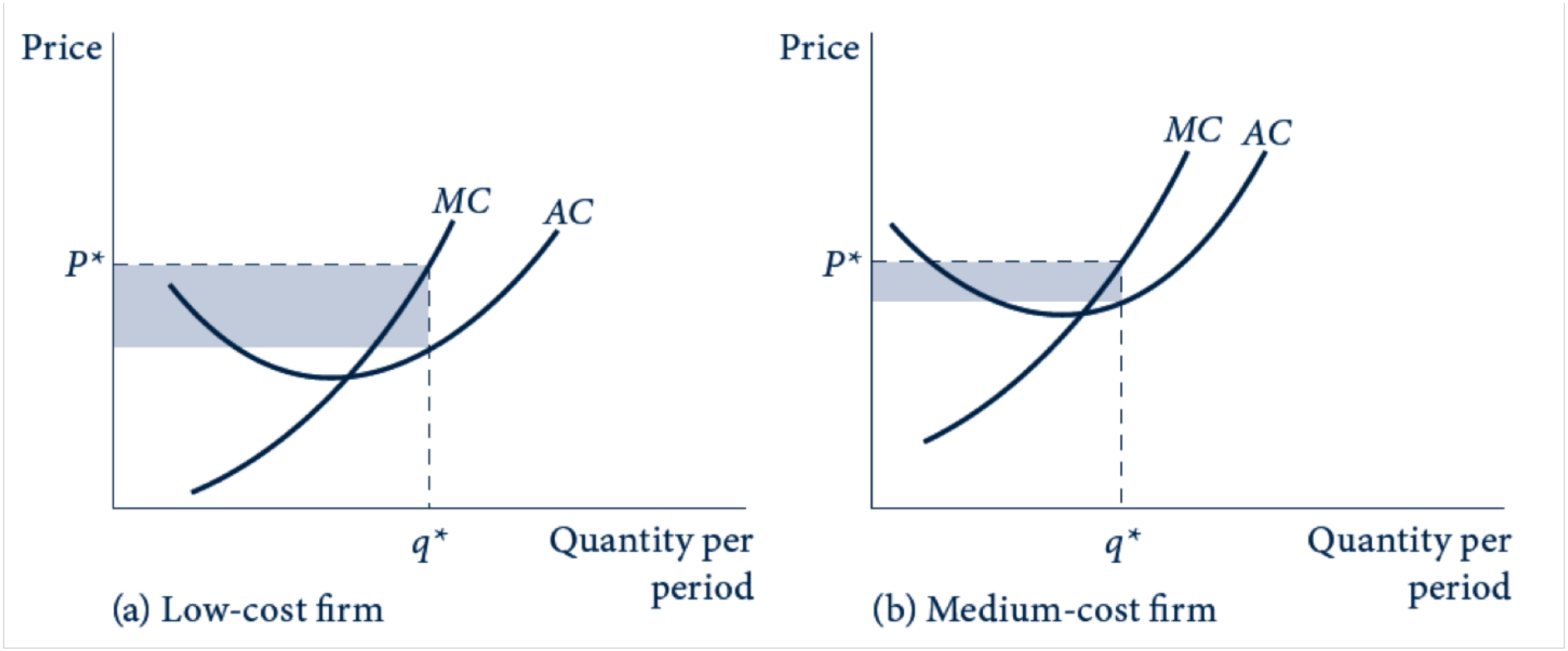
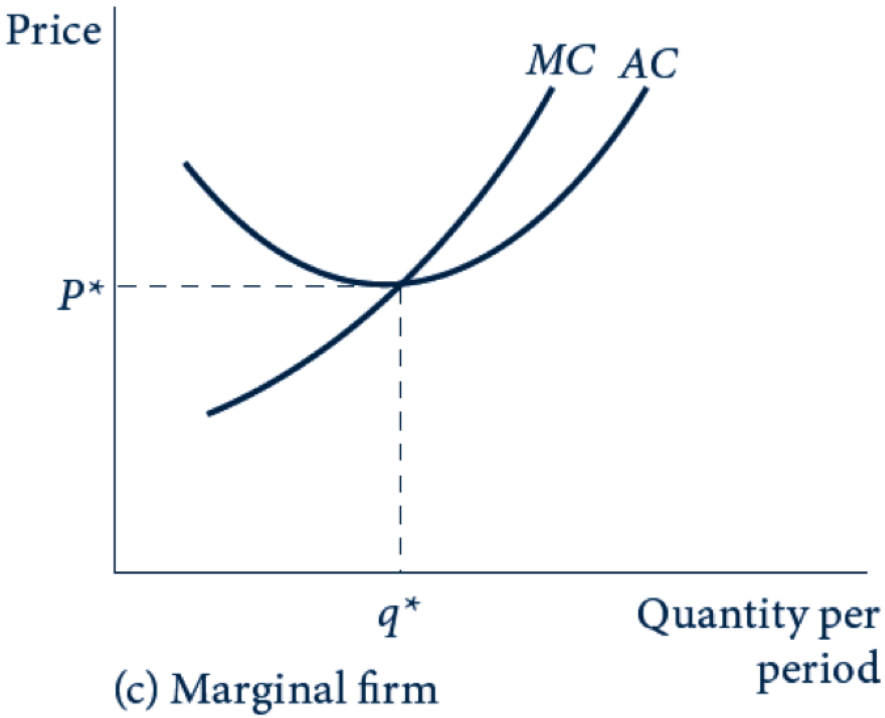
  - The more fertile land is, the higher its price
  - Scarcity of low-cost inputs creates the possibility of Ricardian rent
- Managers could be different in their abilities
- Profits are capitalized into input prices, which (should) reflect the present value of all future profits

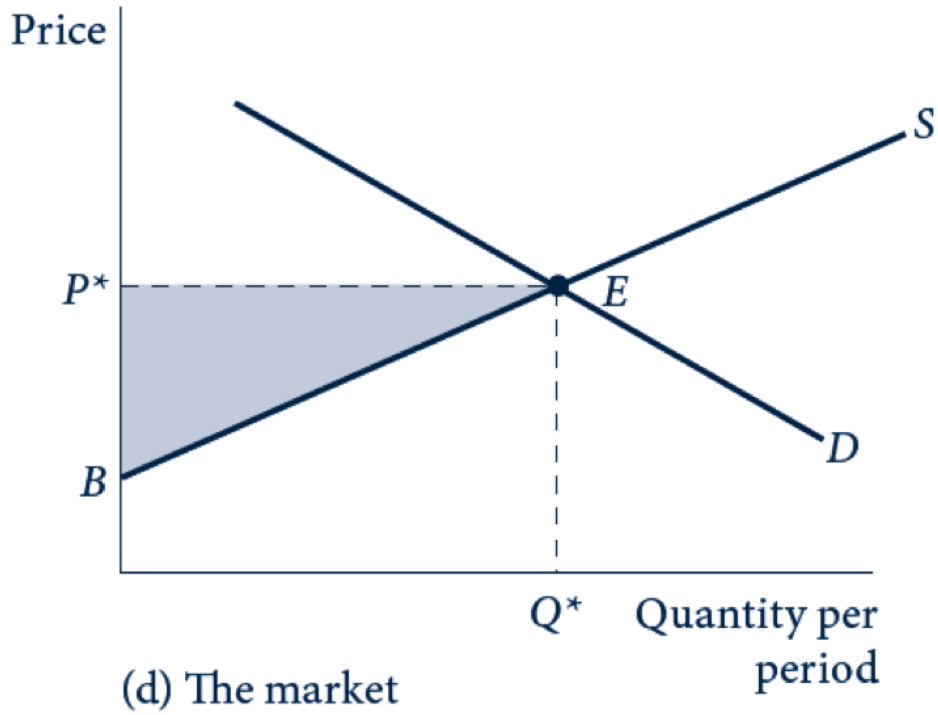
Ricardian rents



Ricardian rents



(c) Marginal firm



(d) The market

Efficiency properties of a perfectly competitive equilibrium

The long-run competitive equilibrium is economically efficient:

- All resources are allocated to their best uses
- All potential surplus is shared by the market participants
- The sum of producer and consumer surplus is maximized
- There are no deadweight losses (DWL) to society

Efficiency properties of a perfectly competitive equilibrium