

International Economics

Increasing Returns to Scale and Trade

Arman Gabrielyan

There are **two** fundamental causes of international trade

1: Country differences

- **1: Technology (productivity):** Ricardo's Model.
- **2: Factor endowments:** Heckscher-Ohlin Model.
- **3: Preferences.**
- **4: Government policy.**

2: Increasing returns to scale

Doubling the inputs more than doubles the output. Thus, the production is more efficient (the costs are lower) at larger scale.

Increasing returns to scale and the rationale for trade

- Assume two countries, Arm and Rus, each possessing the same technology.
- *In autarky* each employs 40 units of labor to produce 250 units of X. Thus, as a whole they employ 80 units of labor and produce 500 units of X.
- *Under free trade* any of the two countries, suppose Rus, may specialize in the production of X and by employing 80 units of labor produce 680 units of X.
- Hence, *due to specialization*, the same amount of labor will produce more units of X, *taking advantage of economies of scale*.

Production technology

Labor input	Output of X	Average labor input
20	100	0.20
40	250	0.16
60	425	0.14
80	680	0.12
100	952	0.11

Per unit cost decreases as production increases.

Increasing returns to scale and the rationale for trade

- But, to produce the extra units of X, Russia must decrease the production of other goods, which then will be produced in Armenia.
- If the production of those goods is subject to economies of scale,
 - then the world production will unambiguously increase, and
 - countries will be able to consume more by trading.
- *Thus, trade makes it possible for countries by specializing and taking advantage of economies of scale to*
 - *produce limited range of goods,*
 - *but consume at least the same variety,*
 - *and higher amount of goods.*
- *Therefore, trade is mutually beneficial.*

Increasing returns to scale and the rationale for trade

Internal vs. External economies of scale

- Increasing returns to scale usually imply a not perfectly competitive market structure.
- Under increasing returns of scale average labor input decreases as production increases. But the increase in production may be due to:
 - existing firms' production increase (*internal economies of scale*, firm size increases), or
 - number of firms' rise (*external economies of scale*, industry size increases).

External economies of scale

100 firms, each produces 100 units of X.

Then industry size doubles, as 200 firms, each produces 100 units of X.

Per unit cost may decrease due to:

- ✓ *access to specialized infrastructure, service suppliers, component manufacturers, and labor (labor pooling), and*
- ✓ *knowledge spillovers.*

Labor pooling: Movie producers choose to locate to Hollywood not in Bangladesh, since there are more blonde actresses and famous directors.

Examples of external economies: • Semiconductors (Silicon Valley)
• Investment banking (New York) • Movies (Hollywood) • Functional carpets (Dalton, Georgia, US, 90% of world) • Toothbrushes (Hangji, China, 30%/80% of world/China) • IT (Bangalore, India).

Internal economies of scale

100 firms, each produces 100 units of X.

Then industry size doubles, as 100 firms, each produces 200 units of X.

Per unit cost may decrease due to:

- *Technical economies of scale (high fixed cost) –*

Production cost: 100 copies of magazine - \$5,000

2000 copies - \$10,000.

The average cost falls from \$50 to \$5 a copy, as the main cost (editorial and design) is not related to the number of copies.

- *Labor division*

- *Bulk buying*

- *Financial economies; etc.*

Examples of internal economies: • Car production; • Cell phone providers;
• Smith's pin factory.

Increasing returns to scale and the rationale for trade

The market structure

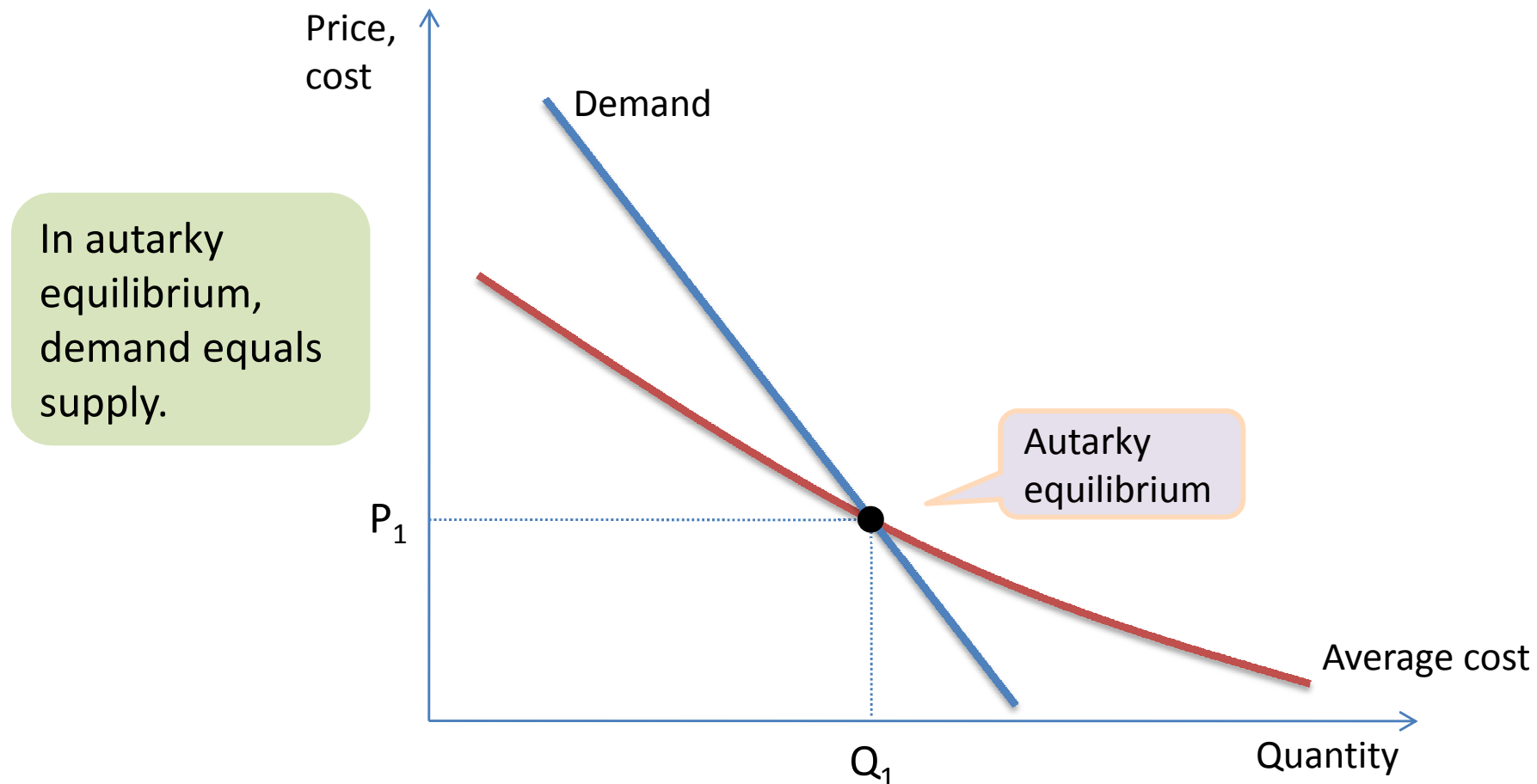
External and internal economies of scale imply **different market structures**.

- *External* economies of scale entails **perfectly competitive** market structure, as the industry consist of many small firms.
- But under *internal* economies of scale large firms have a cost advantage over small ones, which leads to an **imperfectly competitive** market structure.

External economies of scale and Trade

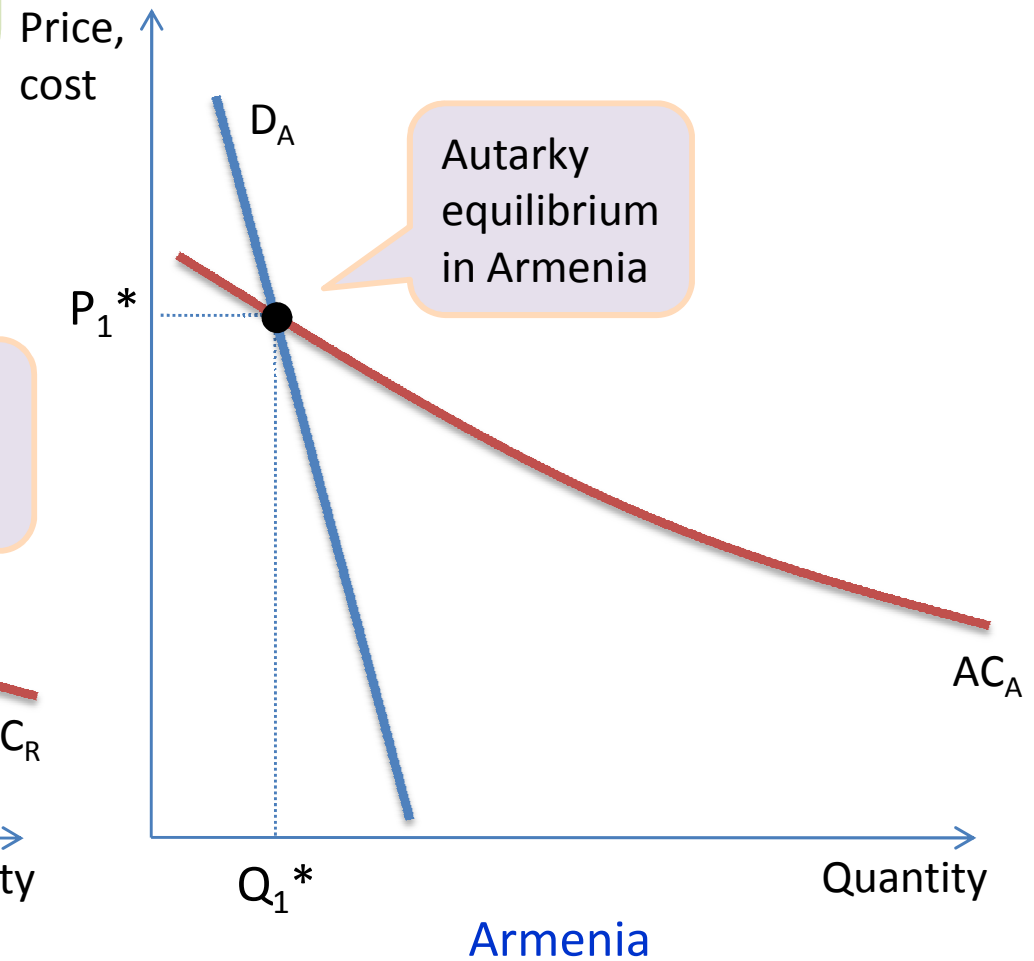
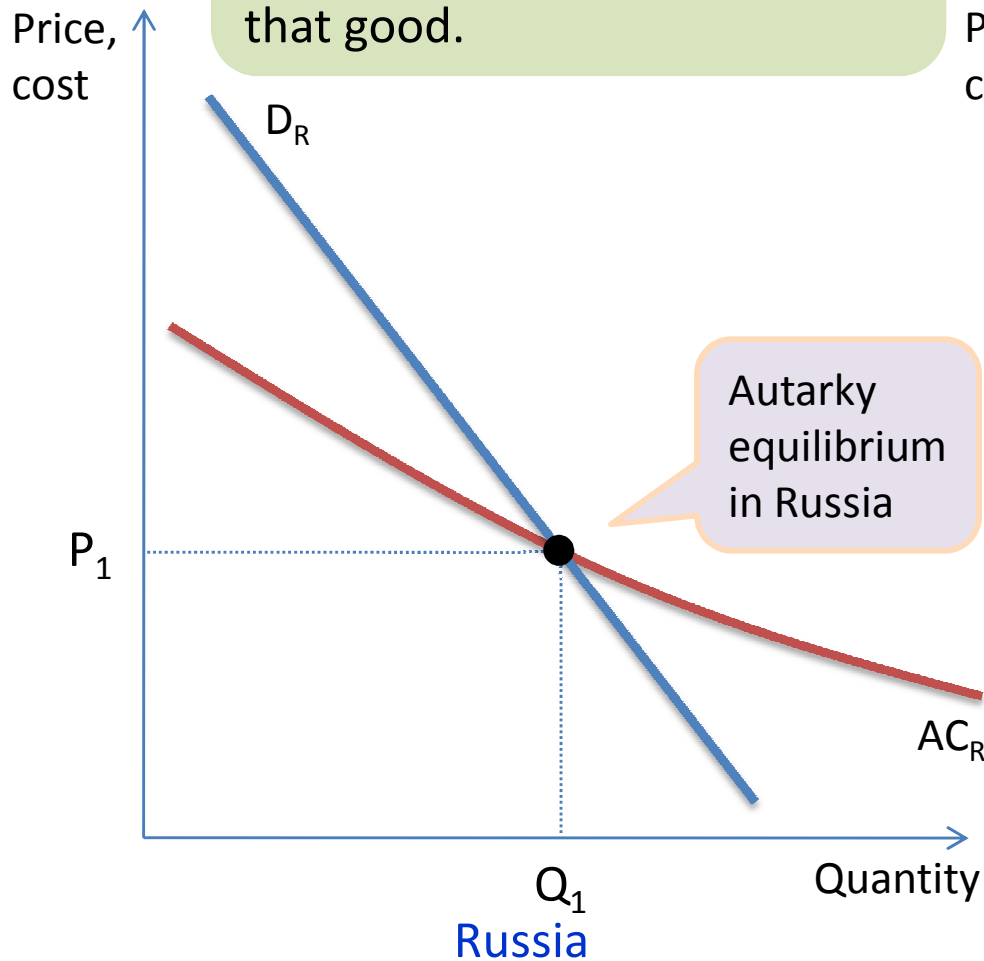
Market equilibrium

- Under external economies of scale the larger the industry, the lower the production costs of each producer, i.e. *industry supply-curve is forward falling*: average costs are falling as the output rises.



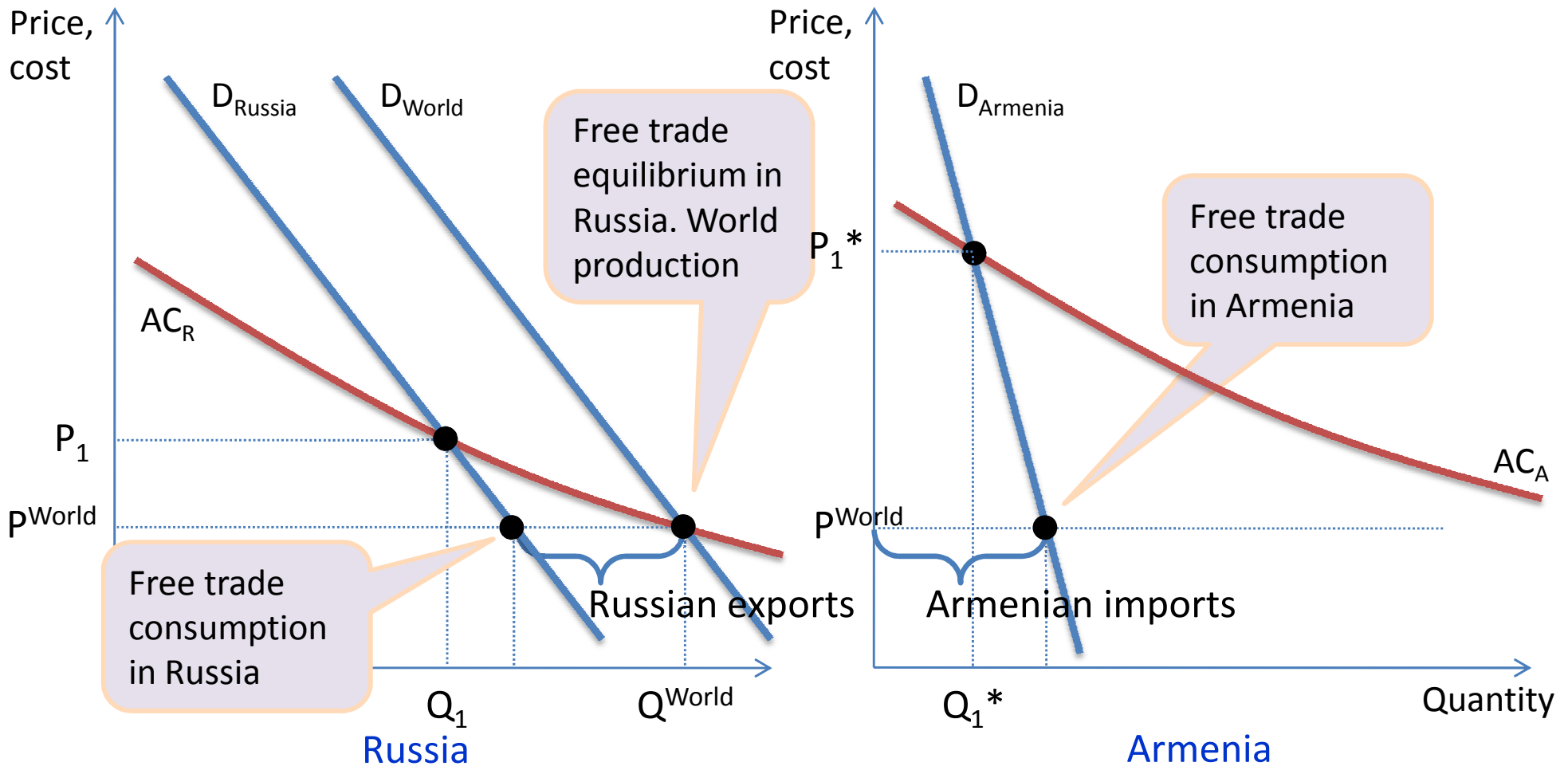
Two country autarky equilibrium

In autarky, the Russian price of good X is lower. Thus, under free trade Russia will export that good.



Two country free trade equilibrium

Under free trade, the X industry will expand in Russia, and contract in Armenia. In the end all X production will concentrate in Russia.



Two country free trade equilibrium

Under external economies of scale

- free trade *world price is lower* than the prices in *either* country before trade, and
- world *production concentrates* in limited number of locations (clusters).

The importance of established advantage

Why costs in one country may be lower than the other?

Qiaotou, China, produces more than 60% of world buttons.

■ Comparative advantage.

There is a good reason that toothbrush is produced in China, rather than in Italy, as it is a labor-intensive production. Toothbrush must be produced there, where cheap labor is readily available. But why necessarily in China, and why in Qiatou? The possible answer is historical contingency.

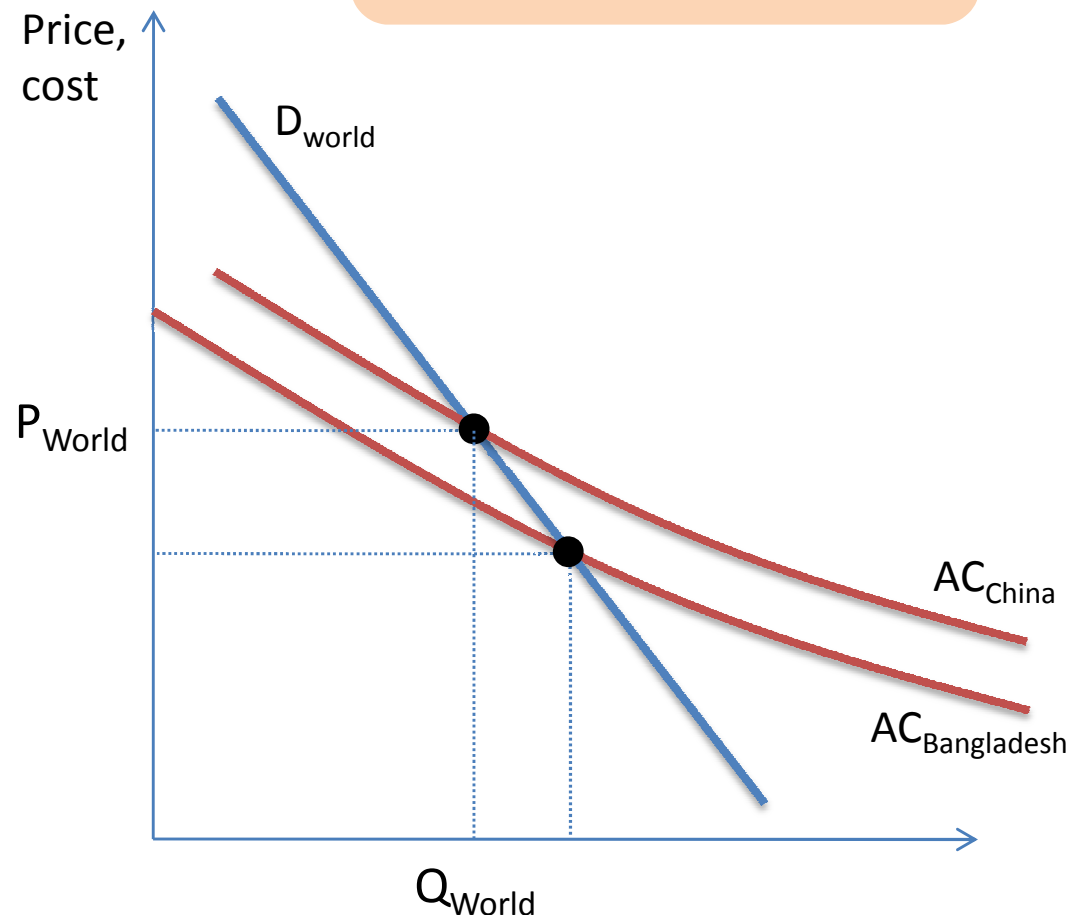
■ Established advantage.

- London became financial center in 19th century, due to Britain being the major power. And remained since, though Britain lost its importance decades ago.*
- Armenia became significant brandy producer due to historical accident of Tairov brothers having an expertise on cognac production.*
- Bangalore, India became world center of IT services due to Tata and Ramsay choosing Bangalore as the site for research university.*

The importance of established advantage

The average cost curve of Bangladesh is below the China's curve. Thus Bangladesh could potentially supply the world market more cheaply. But because Chinese production is already established, it is able to sell toothbrushes at a cheaper price, than Bangladeshi firms would be able if they begin production. Thus, a pattern of specialization established by historical accident may persist.

Hangji, China, produces more than 30% of world toothbrushes.



Internal economies of scale and Trade

Internal economies of scale imply that a firm's average cost of production decreases the more output it produces.

Perfect competition is impossible in this case. As in perfect competition $P = MC$, but AC curve is downward sloping, hence $AC > MC = P$. Thus, firms will incur losses, and will be forced out of the market, until *imperfect competition prevails*.

Monopolistic competition

characteristics

- Large number of producers, selling slightly differentiated products.
- Entry barriers are relatively low.
- Each producer has some price-making power (faces a downward sloping demand curve).
- Increasing returns to scale (decreasing ATC).
- Consumers love variety.
- Economic profit is zero in the long-run (entry eliminates the profits).
- Neither allocative nor productive efficiency is achieved in the long run.

Profits is maximized when $MC = MR$.

Price is higher than marginal cost (allocative inefficiency).

Quantity will be less than under perfect competition (productive inefficiency).

Monopolistic competition model

assumptions

- Demand facing by a typical monopolistically competitive firm:

$$Q = S \times [1/n - b \times (P - P^*)]$$

Q = Quantity of demand

S = Total output of industry (assumed fixed)

n = Number of firms in the industry

b = Constant, sales responsiveness to the price

P = Firms price

P* = Average price of competitors

- When all firms set the same price, the share of each is 1/n.
- When a firm charges higher than average price, its share is less than 1/n.
- When $P < P^*$, its share is higher than 1/n.

Monopolistic competition model

assumptions

■ Cost function:

$$C = F + c \times Q$$

C = Firm's total cost

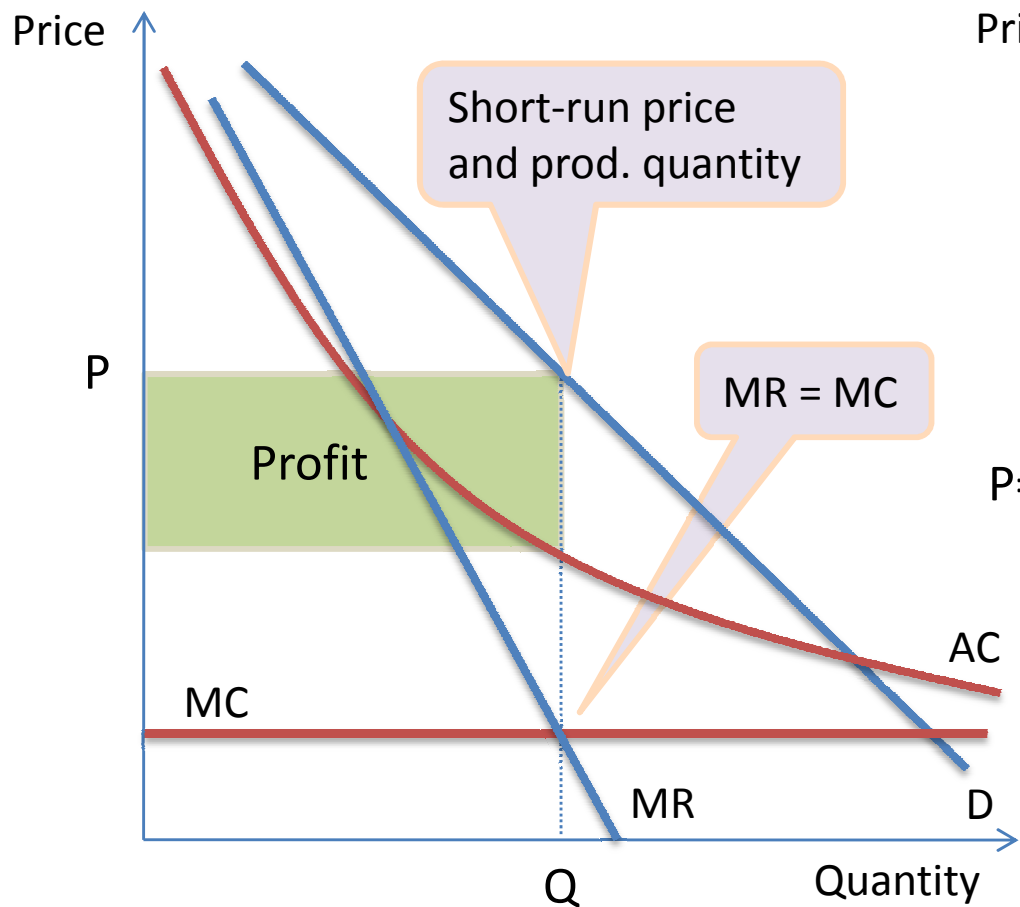
F = Firm's fixed cost

c = Firm's marginal cost

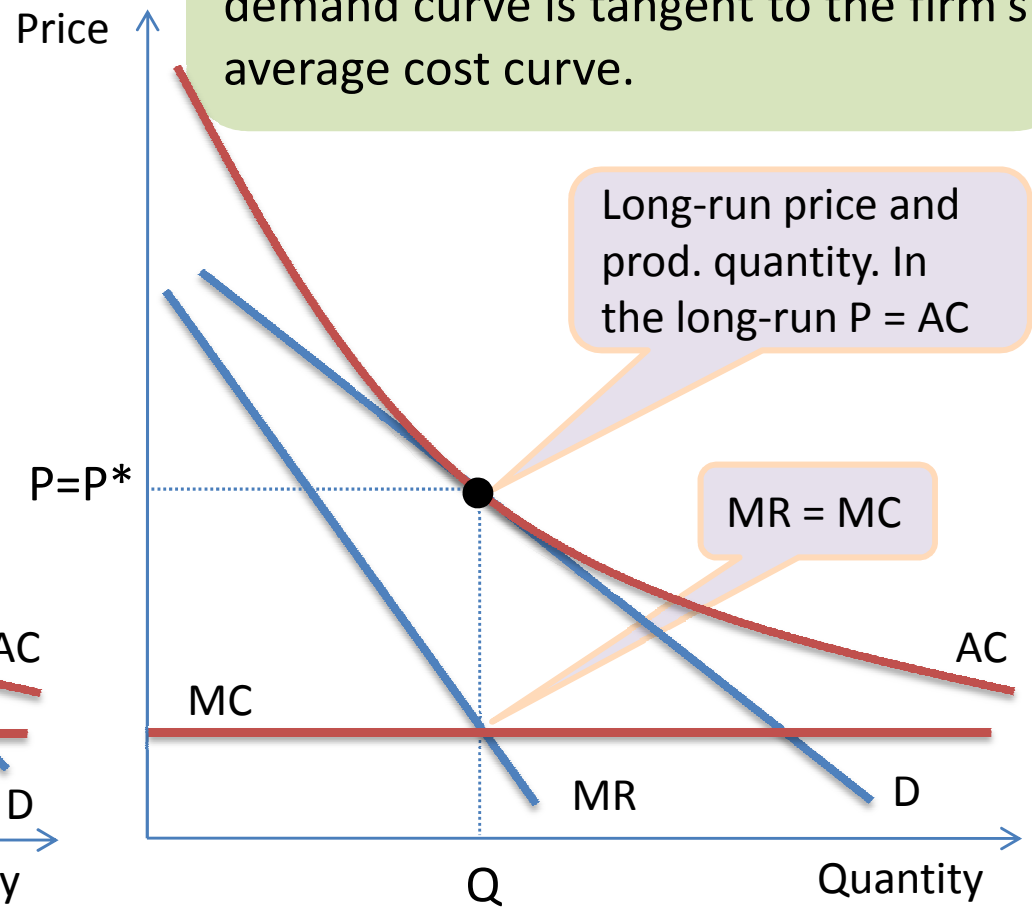
$$\text{Average cost} = AC = C/Q = F/Q + c$$

Assume all firms in the industry are *symmetric*, i.e. demand and cost function are the same for all.

Monopolistic competition model



The profit lures newcomers into the market, until profit vanishes. In the long-run equilibrium the firm's demand curve is tangent to the firm's average cost curve.



Monopolistic competition model

Number of firms and average cost

- All firm's are symmetric, thus in the long-run equilibrium $P = P^*$, and each firm serves the $1/n$ -th of the market: $Q = S/n$.
- Average cost, $AC = F/Q + c = n \times F/S + c$.
the higher is the number of firms in the industry, the higher is average cost

Number of firms and price

- In MC model each firm treats other's prices as given, thus P^* is fixed.

$$Q = S \times [1/n - b \times (P - P^*)] \quad \Leftrightarrow \quad MR = P - Q / (S \times b)$$

$$\text{hint: } MR = d(PQ)/dQ$$

$$\text{Max profit} \quad \Leftrightarrow MR = MC \quad \Leftrightarrow P - Q / (S \times b) = c$$

$$P = c + Q / (S \times b)$$

$$\text{In equilibrium } Q = S/n, \text{ thus } P = c + 1/(n \times b)$$

the higher is the number of firms, the lower the price each firm charges

Monopolistic competition model

Number of firms and average cost

- $AC = n \times F/S + c.$

The higher is the number of firms, the higher is the average cost.

Number of firms and price

- $P = c + 1/(n \times b).$

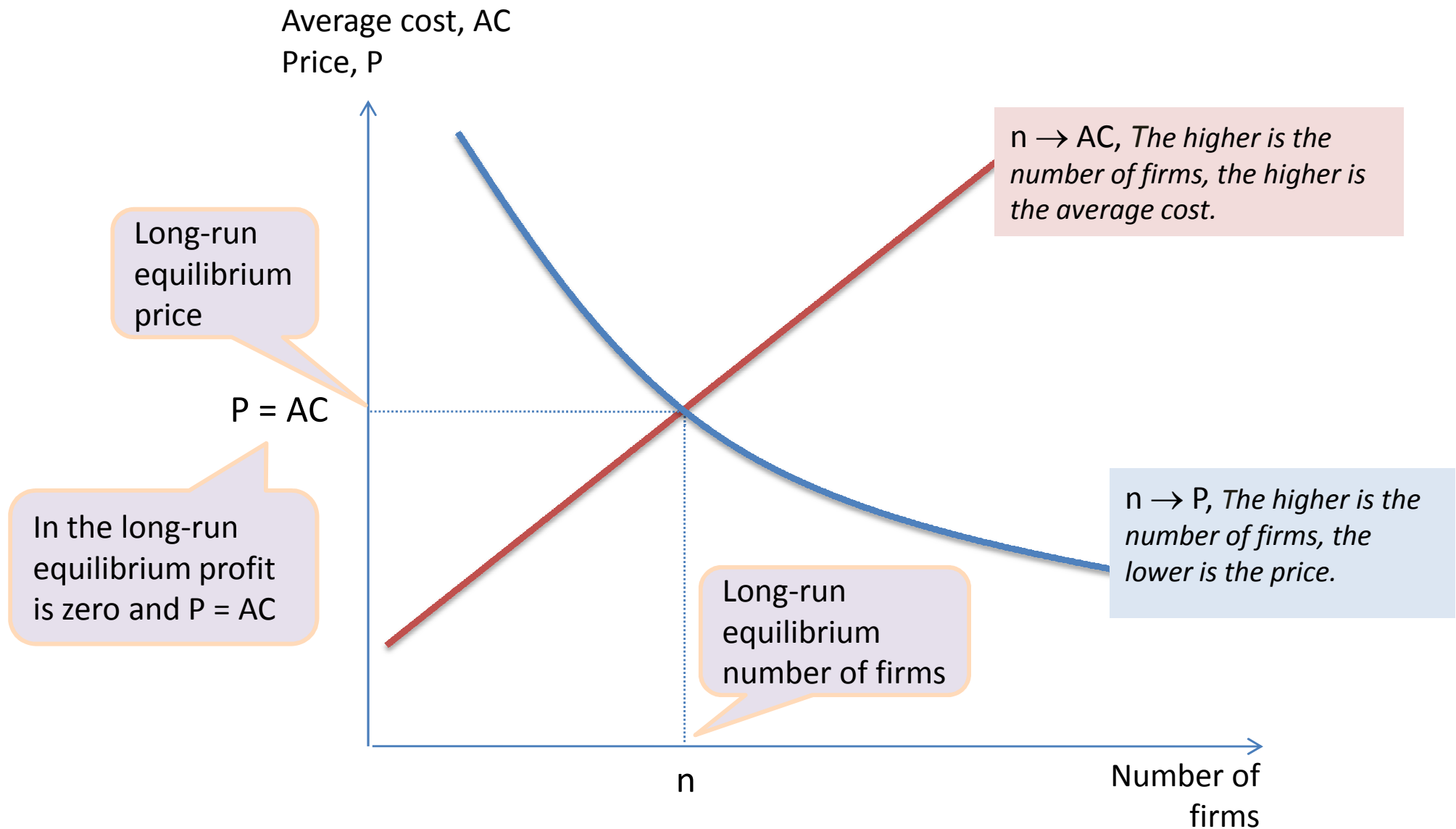
The higher is the number of firms, the lower is the price.

Market equilibrium

- In the long-run equilibrium $P = AC \quad \Rightarrow c + 1/(n \times b) = n \times F/S + c$

$$n^2 = S/(F \times b)$$

Monopolistic competition model



Monopolistic competition & TRADE

Assume two countries. Under autarky, each firm in either country supplies only the national market. But when the two countries liberalize mutual trade, the size of the market for each firm increases. **Trade increases the size of the market.**

Thus, trade increases the industry size, S :

■ $S \uparrow \Rightarrow AC = n \times F/S + c \downarrow$

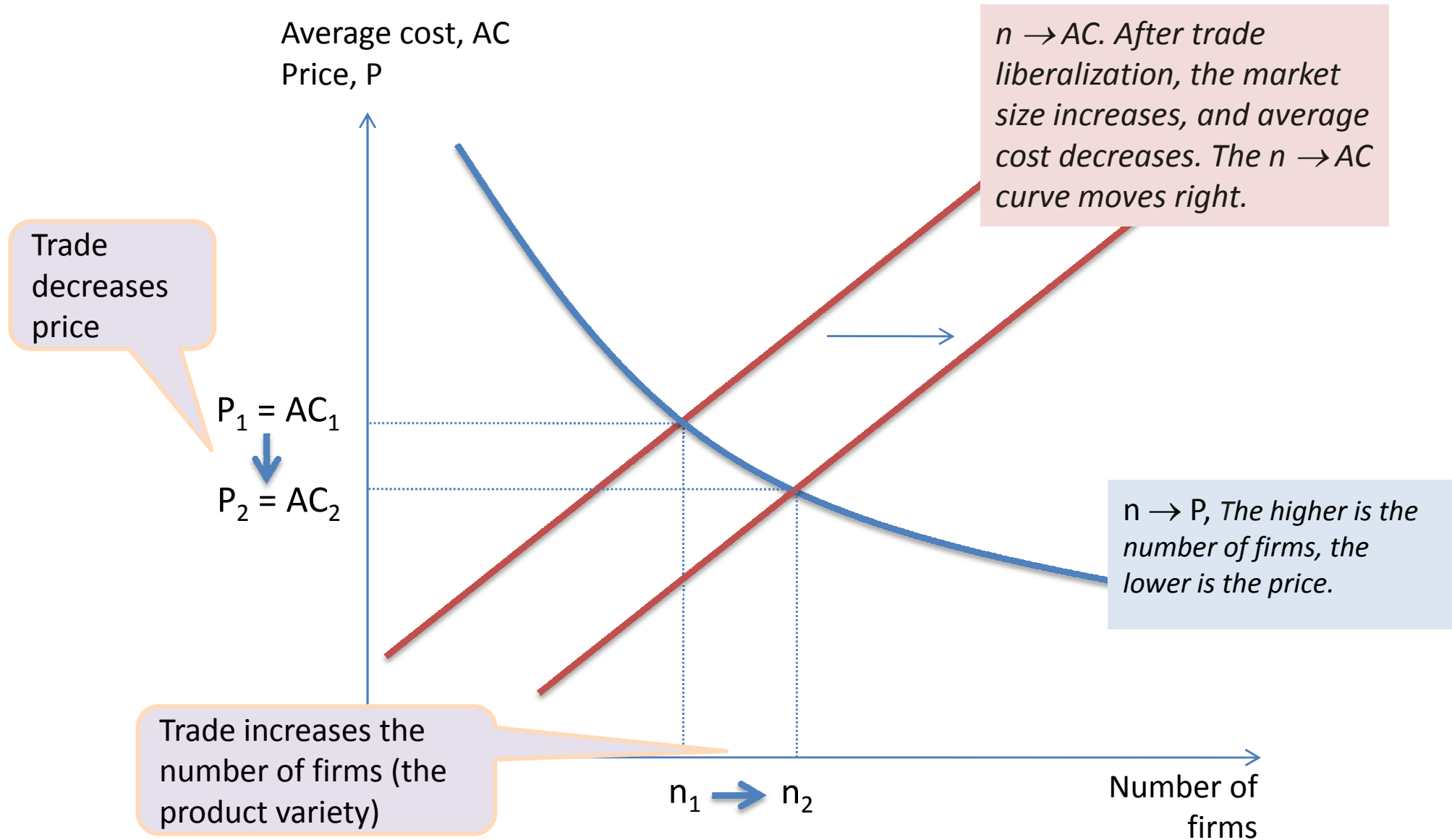
- As the size of the market increases, the sale of each firm increases too, and average cost decreases, due to internal economies of scale.
- As $P = AC$, the decrease of AC decreases P.

The increase of industry size, S , increases the number of firms:

■ $S \uparrow \Rightarrow n^2 = S/(F \times b) \uparrow$

- The increase of the number of firms is equivalent to the increase of product diversity.

Monopolistic competition & TRADE



Numerical example

on Monopolistic competition and Trade

Assume 2 countries, Arm and Rus, and the production of cars.

In autarky, total yearly sales of cars (the size of car industry, S) is

- $S = 1080$ units in Arm, and
- $S = 2430$ units in Rus.

The cost structure in two countries is the same:

- $b = 1/50,$
- $F = 1500,$
- $c = 10.$

Numerical example

on Monopolistic competition and Trade

In Arm

$$Q = S \times [1/n - 1/50 \times (P - P^*)]$$

$$C = 1500 + 10 \times Q \Rightarrow AC = 1500/Q + 10$$

as firms are symmetric, in autarky long-run equilibrium

each firm sells $Q=1080/n$ cars.

$$AC = n \times 1500 / 1080 + 10 \quad \text{and} \quad P = c + 1/(n \times b) = 10 + 1/(n \times 1/50)$$

In the long run equilibrium $P = AC$

$$\Rightarrow 10 + 1/(n \times 1/50) = n \times 1500 / 1080 + 10$$

$$n = 6$$

$$AC = P = 18.33. \quad Q = 1080 / 6 = 180$$

Numerical example

on Monopolistic competition and Trade

In Rus

$$Q = S \times [1/n - 1/50 \times (P - P^*)]$$

$$C = 1500 + 10 \times Q \Rightarrow AC = 1500/Q + 10$$

In autarky long-run equilibrium each firm sells $Q=2430/n$ cars.

$$AC = n \times 1500 / 2430 + 10 \quad \text{and} \quad P = c + 1/(n \times b) = 10 + 1/(n \times 1/50)$$

In the long run equilibrium $P = AC$

$$\Rightarrow 10 + 1/(n \times 1/50) = n \times 1500 / 2430 + 10$$

$$n = 9$$

$$AC = P = 15.56$$

$$Q = 2430 / 9 = 270$$

Numerical example

on Monopolistic competition and Trade

Thus, In autarky

<i>In Arm:</i>	$n = 6;$	$AC = P = 18.33;$	$Q = 180$	$S = 1080$
<i>In Rus:</i>	$n = 9;$	$AC = P = 15.56;$	$Q = 270$	$S = 2430$

Under free trade the size of industry is $S = 1080 + 2430 = 3510$ units of cars.

$AC = n \times 1500 / 3510 + 10$ and $P = c + 1/(n \times b) = 10 + 1/(n \times 1/50)$

$P = AC$ $\Rightarrow 10 + 1/(n \times 1/50) = n \times 1500 / 3510 + 10$

$n = 10.8$

$AC = P = 14.6$

$Q = 3510 / 10 = 324.5$

Numerical example

on Monopolistic competition and Trade

In autarky

In Arm: $n = 6;$ $AC = P = 18.33;$ $Q = 180$ $S = 1080$

In Rus: $n = 9;$ $AC = P = 15.56;$ $Q = 270$ $S = 2430$

Under free trade in the world

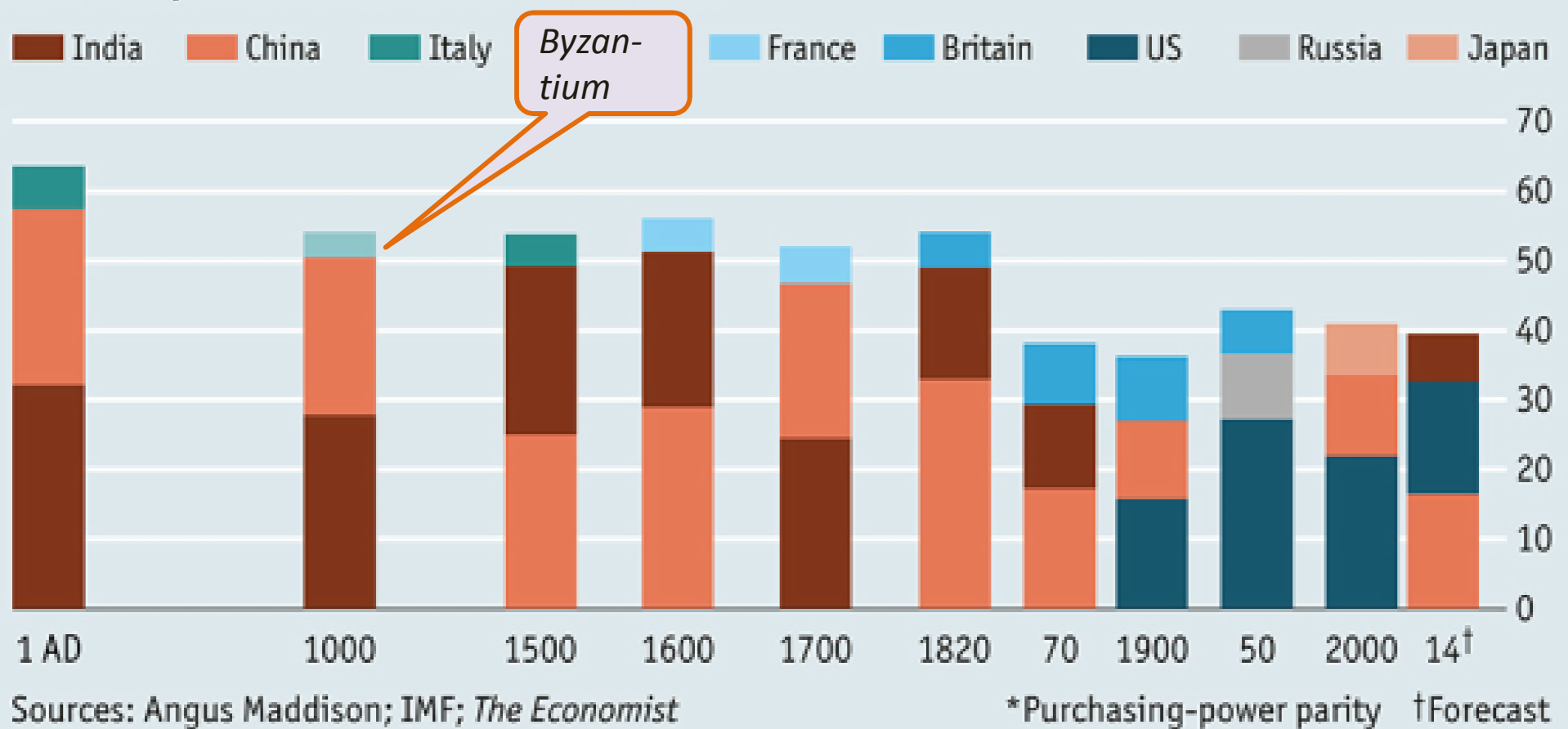
$n = 10.8$ $AC = P = 14.6;$ $Q = 324.5$

In the integrated world

- *Number of firms is more than in any country under autarky, but less than in two countries combined.*
- *The sale of each firm increases.*
- *The price decreases.*

World's biggest three economies, GDP at PPP* as % of world total

Historical output within the boundaries of modern countries



China has been the world's biggest economy in purchasing-power-parity terms for much of recorded history.

Source: Economist.