Industrial Organization I

EC 3322

Semester I – 2008/2009

- Prerequisites: **EC2101**
- Readings:
  - Textbooks:
    - Carlton, Dennis and Jeffrey Perloff (2005), *Modern Industrial Organization*, Pearson-Addison Wesley. (**CP**).

      An elementary textbook that gives excellent coverage of theoretical and practical applications of industrial organization.

    - Peppal, Lynne, Daniel Richards, and George Norman (2005), *Industrial Organization: Contemporary Theory and Practice*, Thomson-South Western. (**PRN**).

      This is the second main textbook after CP. I will combine both textbooks.

  - Some additional articles that will be given through IVLE.

- **Assessment**:
  - **Class Participation** **10%**
    - Please be prepared for every class. The participation mark will be a consolidated score for attendance, and activity in (class?) and tutorials (i.e. questions and discussions) or in forum created in IVLE.
  - **Assignments** **30%**
    - Each student will have to hand in three written assignments (each of them has 10% weight). In these assignments, students will have to solve some problem sets.
    - The exact dates in which the assignments are given and the due date for these assignments will be announced later.
    - In preparing your assignments, you are encouraged to discuss how to solve them with your fellow students. You can form a study group or utilize the IVLE forum. However, each of you should prepare your own answers separately. Do not copy the answers of your fellow students literally!!.
  - **Final Exam** **60%**

- Further Notes:
  - There will be in total about 6 or 7 tutorial sessions. During the tutorials we will discuss the solutions to the problem sets given earlier and also some potential applications of the theories learned in class.
  - In total there will be six (6) problem sets assignments, and each of you will have to hand in three (3) out of these six.. Which problem sets you will have to hand in will be made known to you in due course.
- Requirements:
  - Basic microeconomics
  - Some basic knowledge of game theory
  - Basic mathematics → basic calculus (know how to differentiate) and solving optimization without constraint.

Topic 1:
Introduction and Overview

EC 3322

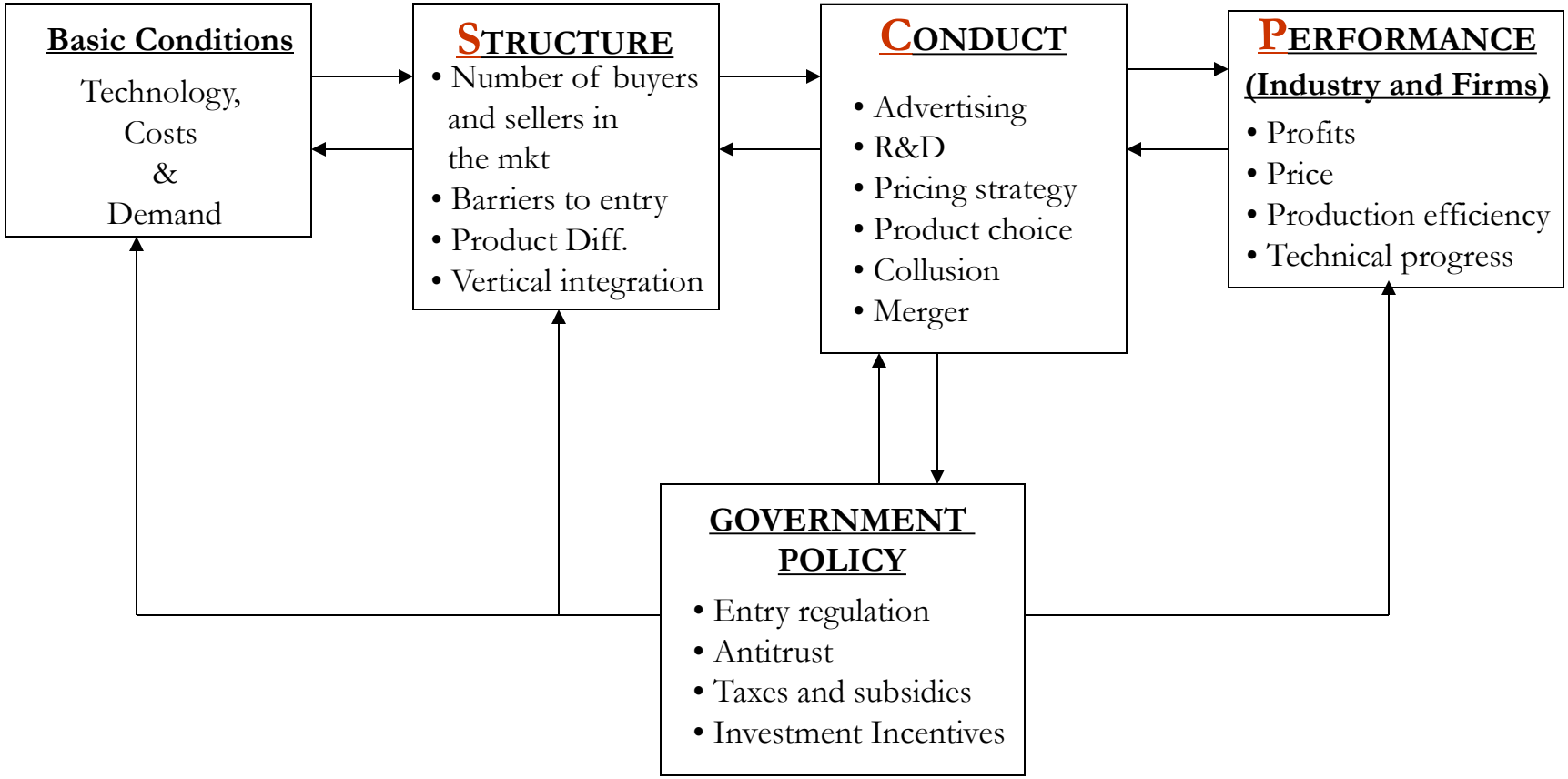
Semester I – 2008/2009

What is IO (Industrial Organization)?

- **IO** is an applied microeconomics field that studies **market structure** and **behavior of firms** and their **consequences**.
- In microeconomics course, you would probably have learned; 1) the neoclassical theory of firm, 2) perfect competition, and 3) monopoly.
- Thus, the focus is on the behavior of firms operating in two most extreme market structures (perfect competition vs. monopoly). What happen when we have a market structure in between those two? → common in real world → IO studies the whole range of spectrum.
- The analytical tools: Microeconomics Theory and Game Theory.
- Why Game Theory? → Because we study a firm's optimal competitive strategy as a response to the opponents' optimal competitive strategy → this discussion is absent in both the perfect competitive and monopoly settings.

What is IO (Industrial Organization)?

- Another way of looking at IO.



Topics (tentative)

1. Introduction (week 1/ 12-08-08)
2. Microeconomics Review: Costs (week 1/ 12-08-08)
3. Microeconomics Review: Perfect Competition (week 1 & 2/ 12-08-08 & 19-08-08)
4. Microeconomics Review: Monopoly (week 2/ 19-08-08)
5. Oligopoly: Nash Equilibrium, Cournot Competition, Bertrand Competition and Stackelberg Competition (week 3 & 5/ 26-08-08 & 09-09-08)
6. Product Differentiation and Monopolistic Competition: Representative Consumer Model, Horizontal and Vertical Product Differentiation (week 6&8/16-09-08 & 30-09-08)

No Lecture (week 4/ 02-09-08) **and Recess Week** (week 7/ 23-09-08)

Topics …

7. Collusion and Cartels (Week **9**/ 07-10-08)
8. Price Discrimination (Week 10/ 14-10-08)
9. Other Pricing Strategies: Nonlinear Pricing, Bundling and Tie-In Sales (Week 11/ 21-10-08)
10. Anticompetitive Strategic Behavior: Predatory Pricing, Limit Pricing, Raising Rivals' Cost, and Contract as a Barrier to Entry (Week 12/ 28-10-08)
11. Vertical Integration and Vertical Restraints (Week 13/ 04-11-08)
12. Horizontal Mergers (Week 14/ 11-11-08)
13. Research and Development (Week 14/ 11-11-08)

Topic 2:
Microeconomics Review: Costs

EC 3322

Semester I – 2008/2009

Types of Costs

- **Fixed Costs (F)**: costs that do not vary with output (e.g. fixed wages given to employees, license contract, rental fee) → incurred every period.
- **Sunk Costs**: portion of fixed costs that is **not recoverable**. Once sunk, it should not affect any subsequent decisions → e.g. costs of analyzing the market, developing a product, establishing a factory → sunk cost fallacy → continuing an activity because money and effort has been exerted.
- **Avoidable Costs**: Costs, including fixed costs, that are not incurred if operations stop.
- **Variable Costs**: Costs that vary with the level of output, q. → **VC(q)**.
- **Total Costs (C)** = F + VC
  - Marginal Cost : $MC = \frac{\partial C(q)}{\partial q}$

Types of Costs

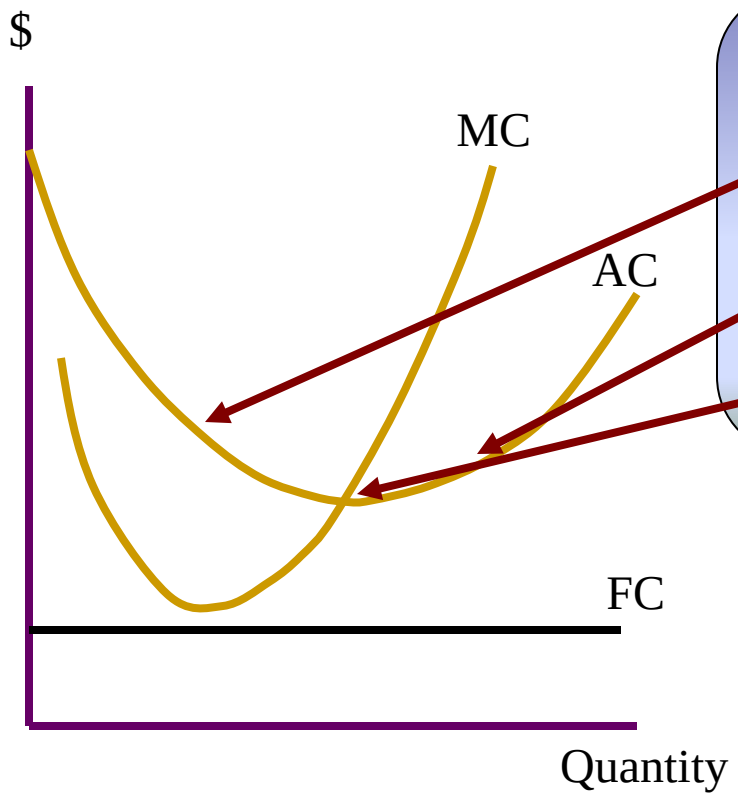
- Average Cost $AC = \frac{C}{q}$
- Average Variable Cost : $AVC = \frac{VC(q)}{q}$
- Average Fixed Cost : $AFC = \frac{F}{q}$

$$AC(q) = \frac{C(q)}{q} = \frac{VC(q) + F}{q} = \frac{VC(q)}{q} + \frac{F}{q}$$
$$= AVC(q) + AFC(q)$$

- AVC and AFC cannot exceed AC
- MC could be higher or lower than AC.

Cost Curves: An Illustration

Typical average and marginal cost curves



Relationship between AC and MC

If MC < AC then AC is falling

If MC > AC then AC is rising

MC = AC at the minimum of the AC curve

AC starts increasing as capacity constraints becomes binding. U-shape implies cost disadvantage for very small and very large firms

Unique optimum size for a firm

Marginal & Average Cost Functions

$$AC = \frac{C(q)}{q}$$

$$\frac{\partial AC}{\partial q} = \frac{q\dfrac{\partial C(q)}{\partial q} - C(q)}{q^2} = \frac{qMC(q) - C(q)}{q^2}$$

$$\frac{\partial AC}{\partial q} < 0 \text{ if } qMC(q) - C(q) < 0 \text{ or } MC(q) < \frac{C(q)}{q} = AC(q)$$

$$\frac{\partial AC}{\partial q} \geq 0 \text{ if } qMC(q) - C(q) \geq 0 \text{ or } MC(q) \geq \frac{C(q)}{q} = AC(q)$$

If MC < AC then AC is falling

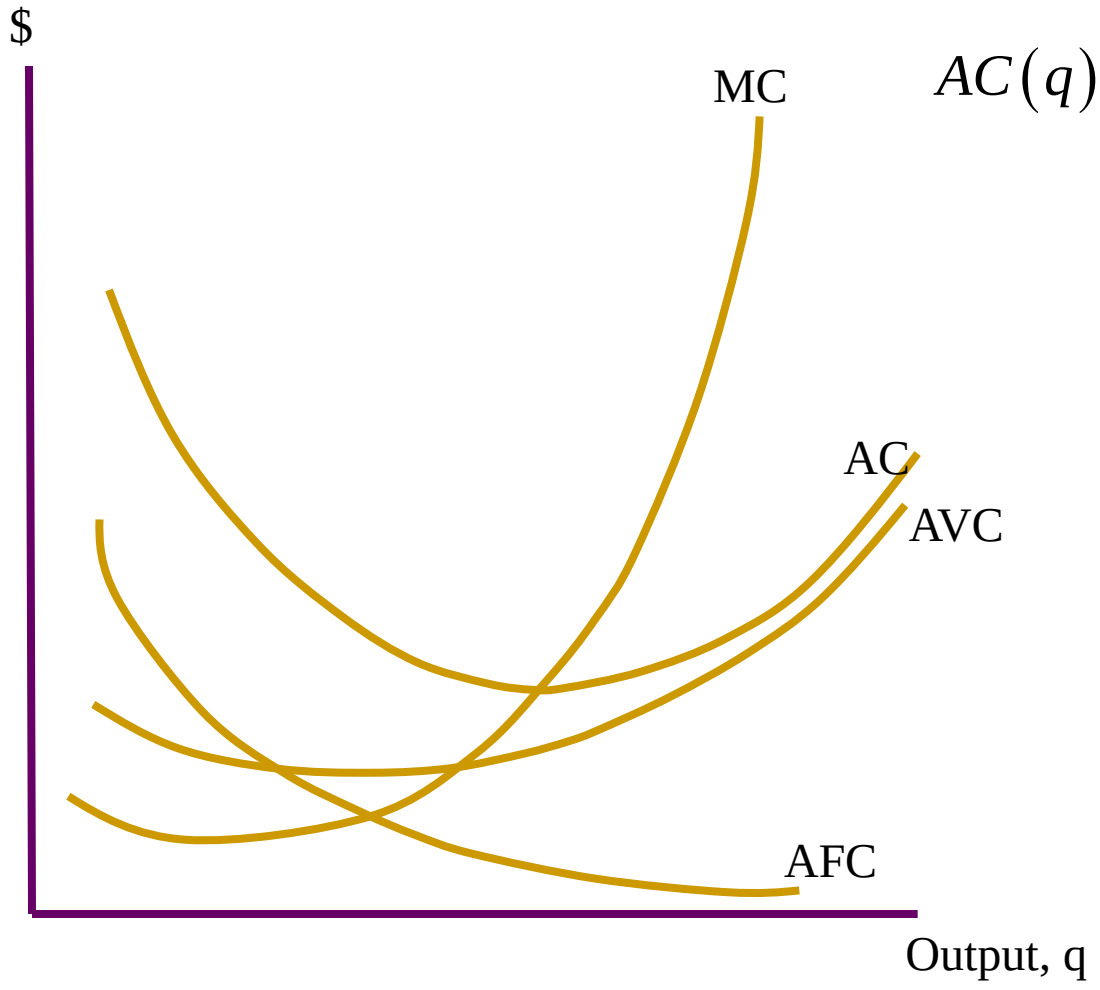
If MC > AC then AC is rising

MC = AC at the minimum of the AC curve

An Example

q	F	AFC	VC	AVC	C	AC	MC
0	100		0		100		
1	100	100	10	10	110	110	10
2	100	50	19	9.5	119	59.5	9
3	100	33.3	25	8.3	125	41.7	6
4	100	25	32	8	132	33	7
5	100	20	40	8	140	28	8
6	100	16.7	49	8.2	149	24.8	9
7	100	14.2	60	8.6	160	22.9	11
8	100	12.5	73	9.1	173	21.6	13
9	100	11.1	88	9.8	188	20.9	15
10	100	10	108	10.8	208	20.8	20

Another Illustration

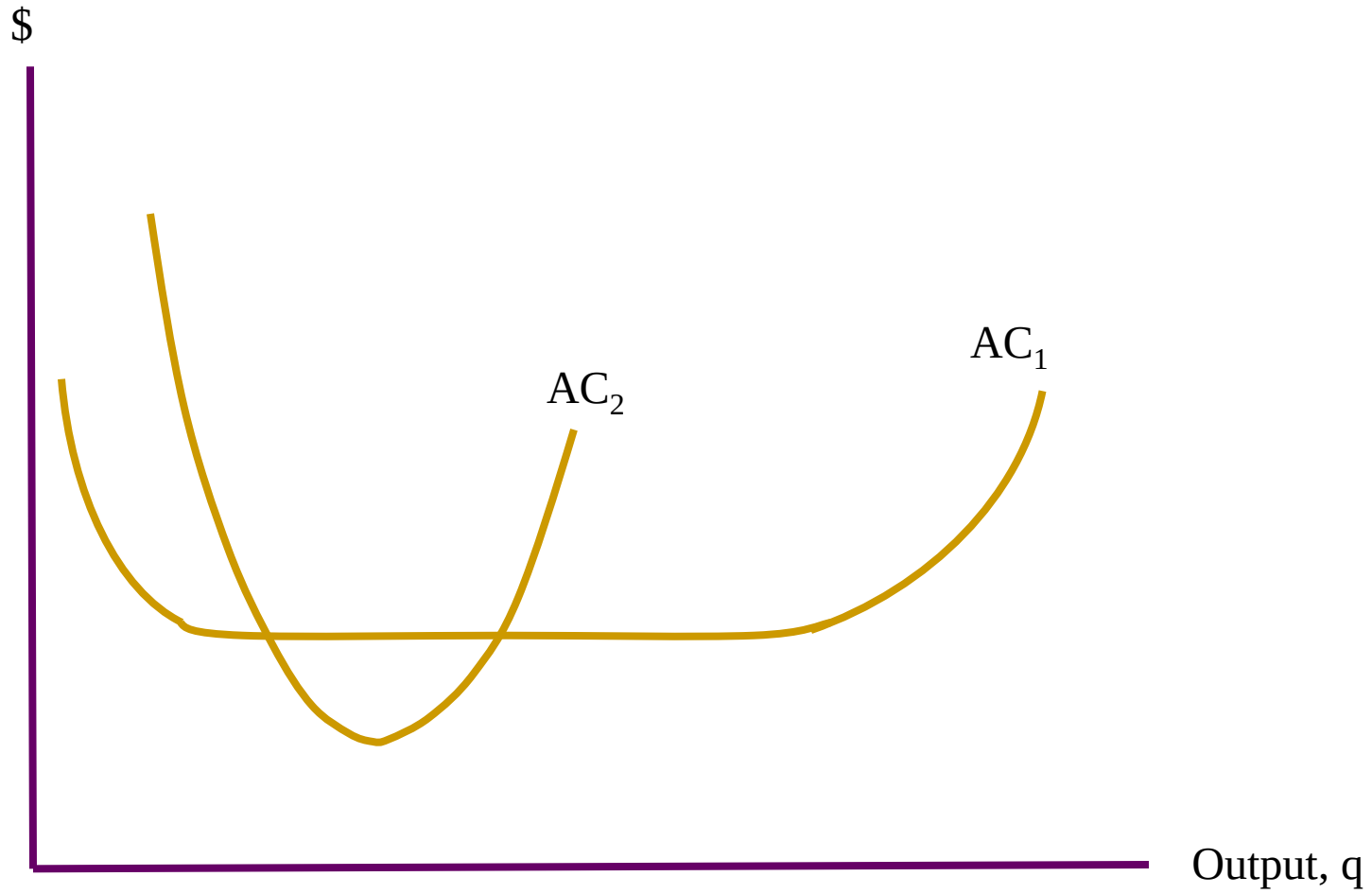


$$AC(q) = \frac{C(q)}{q} = \frac{VC(q) + F}{q}$$

$$= \frac{VC(q)}{q} + \frac{F}{q}$$

$$= AVC(q) + AFC(q)$$

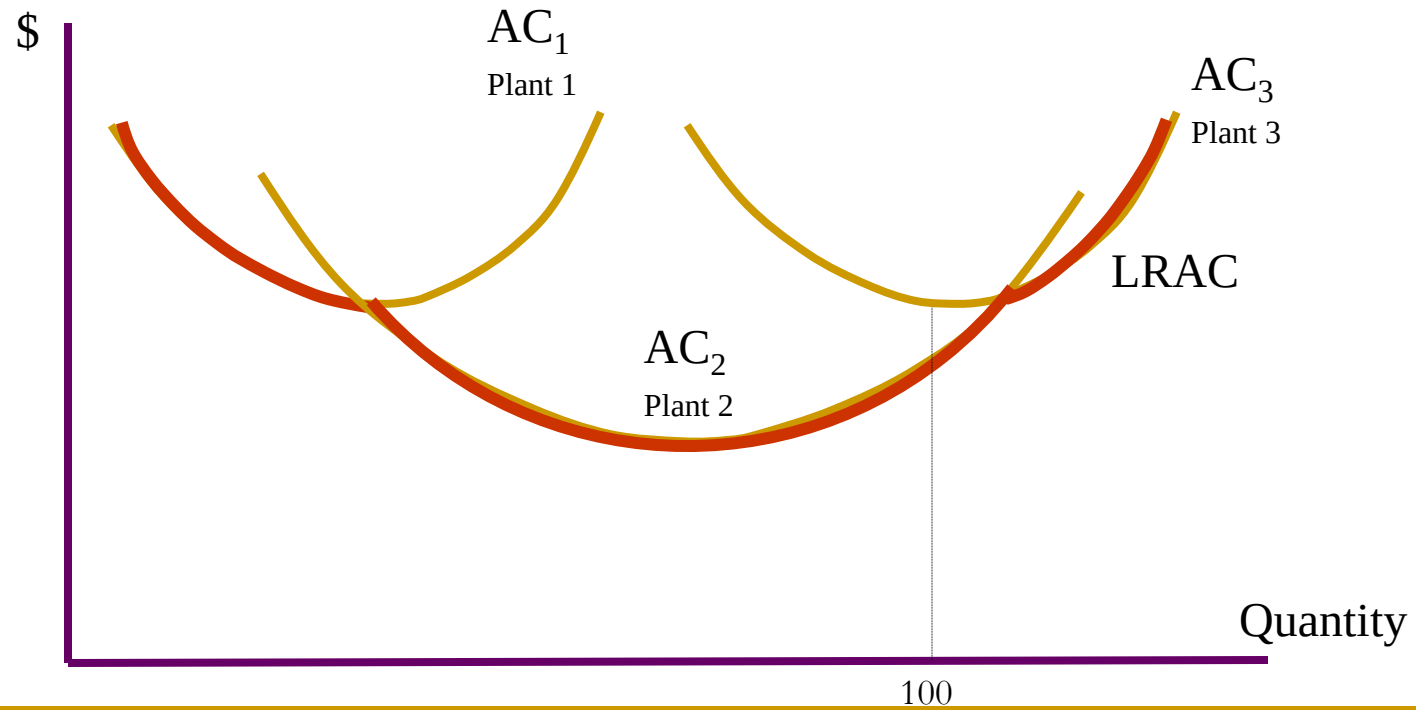
Cost Curves: Different Technologies



Short-Run vs. Long-Run Cost Curve

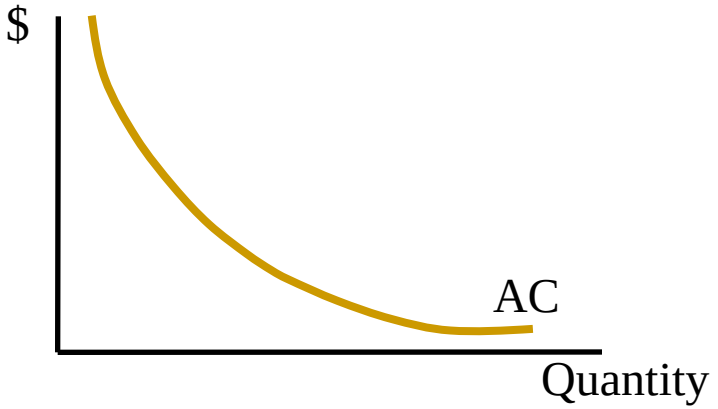
- **Short-Run Cost**: In the short-run, a firm cannot vary factors of production without incurring substantial costs.

- **Long-Run Cost**: In the long-run, there is enough time to expand such that all factors of production can be varied without incurring substantial costs.



Economies of Scale

- **Economies of Scale**: average cost (AC) **falls** when **output increases** → increasing returns to scale → when MC<AC.
- **Constant Returns to Scale**: average cost do not vary with output.
- **Diseconomies of Scale**: average cost rises with output → decreasing returns to scale.
- If a firm enjoys economies of scale at all output levels, then it is efficient to have one firm to produce the entire market output → **natural monopoly**.
- Sources of economies of scale:
  - Large fixed setup cost
  - Transportation cost
  - R&D



Economies of Scale …

- Measure of economies of scale *(**Scale Economy Index**)*:

$$S = \frac{C(q)}{MC(q)q} = \frac{AC(q)}{MC(q)}$$

  - S>1 : Economies of Scale
  - S<1 : Diseconomies of Scale
  - S is the inverse of the elasticity of cost with respect to output

$$\eta_C = \frac{\partial C(q)}{C(q)} \Big/ \frac{\partial q}{q} = \frac{\partial C(q)}{\partial q} \Big/ \frac{C(q)}{q}$$

$$= \frac{MC(q)}{AC(q)} = \frac{1}{S}$$

Multi-product Firms

- Most firms produce more than one product → examples: Honda produces cars and motorcycles, Microsoft produces Windows operating system and several MS Office.
- How do we define average cost for this type of firm? (e.g. produces 2 products)
  - The total cost: $C(q_1,q_2)$
  - Marginal cost of products 1 and 2:

$$MC_1 = \frac{dC(q_1,q_2)}{dq_1} \qquad MC_2 = \frac{dC(q_1,q_2)}{dq_2}$$

  - But <u>average cost is hard to define in general</u> → we use ***Ray Average Cost***.

Ray Average Cost

- Assume that a firm makes two products, 1 and 2 with the quantities q_1 and q_2 produced in a constant ratio of 2:1.
- Then total output Q can be defined implicitly from the equations $q_1 = (2/3)Q$ and $q_2 = (1/3)Q$.
- More generally: assume that the two products are produced in the ratio λ_1/λ_2 (with $\lambda_1 + \lambda_2 = 1$).
- Then total output is defined implicitly from the equations $Q_1 = \lambda_1 Q$ and $Q_2 = \lambda_2 Q$.
- Ray Average Cost:

$$RAC(Q) = \frac{C(\lambda_1 Q, \lambda_2 Q)}{Q}$$

Ray Average Cost …

- Example: consider the following cost function,

  $C(q_1, q_2) = 10 + 25q_1 + 30q_2 - 3q_1 q_2 /2$

- Marginal cost for each product,

$$MC_1 = \frac{dC(q_1, q_2)}{dq_1} = 25 - \frac{3}{2}q_2$$

$$MC_2 = \frac{dC(q_1, q_2)}{dq_2} = 30 - \frac{3}{2}q_1$$

- Ray average costs: assume $\boldsymbol{\lambda_1 = \lambda_2 = 0.5}$, thus we have $q_1 = 0.5Q$; $q_2 = 0.5Q$.

$$RAC(Q) = \frac{C(0.5Q, 0.5Q)}{Q} = \frac{10 + 25Q/2 + 30Q/2 - 3Q^2/8}{Q}$$

$$= \frac{10}{Q} + \frac{55}{2} - \frac{3Q}{8}$$

Ray Average Cost …

- Now suppose $\lambda_1 = 0.75$ and $\lambda_2 = 0.25$,

$$RAC(Q) = \frac{C(0.75Q, 0.25Q)}{Q} = \frac{10 + 75Q/4 + 30Q/4 - 9Q^2/32}{Q}$$

$$= \frac{10}{Q} + \frac{105}{4} - \frac{9Q}{32}$$

Economies of Scale (Multiproduct Firm)

- Measure of economies of scale with multiple products

$$S = \frac{C(q_1, q_2)}{MC_1 q_1 + MC_2 q_2}$$

- This is by analogy to the single product case. It relies on the implicit assumption that output proportions are *fixed*. So we are looking at *ray average costs* in using this definition.

Economies of Scale for Multi-product Firms

- For our example:

$$S_1 = \frac{C(q_1, q_2)}{MC_1 q_1 + MC_2 q_2}$$

$$= \frac{10 + 25q_1 + 30q_2 - 3q_1 q_2 / 2}{25q_1 + 30q_2 - 6q_1 q_2 / 2} > 1$$

- Thus, since S>1, the cost function exhibit *global economies of scale*.

Economies of Scope

- **Definition**: A technology exhibits economies of scope if the costs of supplying two products jointly is lower than supplying them separately.
- Firm 1 produces 1 and 2. Firm 2 produces 1. If the costs of producing 1 is smaller for Firm 1 than Firm 2, there are economies of scope.

Economies of Scale …

Example 1:

Fixed Telephone Lines in Hotel Rooms

Why does it cost a lot to call from a hotel room? → Fixed phone lines are provided as part of room facility, but they are costly (large fixed costs) as the hotel will have to pay whether or not the rooms are occupied → hotel business is seasonal and rooms are not always occupied → hotels typically charge high phone fee.

But with the advance of cell-phones → guests can use cell-phones or just need to buy prepaid cell phone line → it becomes cheaper to call using cell-phones than the hotel fixed lines.

There has been some allegations that hotels buy cell phone jamming device from some providers → this device can block cell phone reception without the cell phone users even realize it.

Source: C. Elliot, "Mystery of the Cell Phone that Doesn't Work at the Hotel," *New York Times*, Sept. 7, 2004, as quoted by Peppal, Richards and Norman, "Industrial Organization, 4E".

Economies of Scale …

Example 2:

Braille Dots at Drive-up ATM Machines

Obviously, drivers cannot be visually impaired. But drive-up ATM machines (e.g. in the US) usually provide Braille dots for the visually impaired in the ATM keypads. Why bother to provide these Braille dots?

Answer: Economies of scale is the reason → Banks typically provide ATM machines with Braille dots in the keypads for the walk-up machines anyway → Need to incur costs of designing and manufacturing the keypads with Braille dots → Once it has been done, it simply just cheaper to make all the machines in the same way rather than keep separate machines and make sure they are installed in the correct locations.

Source: Franks, Robert, "The Economic Naturalist: In Search of Explanations for Everyday Enigmas", (2007).

Economies of Scope …

$$C(q_1, q_2) < C(q_1, 0) + C(0, q_2)$$

- This implies (since C(0,0)=0):

$$C(q_1, q_2) - C(q_1, 0) < C(0, q_2) - C(0, 0)$$

- Thus, the incremental costs of producing Q_2 are lower if you have produced Q_1 already.

- Measure of Economies of Scope:

$$S_C = \frac{C(q_1, 0) + C(0, q_2) - C(q_1, q_2)}{C(q_1, q_2)}$$

- If: $S_C < 0$: No Economies of Scope

  $S_C > 0$: Economies of Scope

Economies of Scope …

- Back to our cost example: $C(q_1, q_2) = 10 + 25q_1 + 30q_2 - 3q_1 q_2 /2$
- The degree of economies of scope:

$$S_C = \frac{C(q_1,0)+C(0,q_2)-C(q_1,q_2)}{C(q_1,q_2)}$$

$$= \frac{20+25q_1+30q_2-(10+25q_1+30q_2-3q_1q_2/2)}{\underbrace{10+25q_1+30q_2-3q_1q_2/2}_{C(q_1,q_2)>0}} > 0$$

Examples:

- Disney Corp. The co. has expanded its core business ever since its inception. Originally, it was only an animated movie producer, and now it has become a multi businesses company → animated and non animated movies production, TV channel distribution, theme parks, toy and merchandise company, retailing, etc.

- Nestle. This is a multi-product company that is active in food related industries. Its well-known products are among others; Nescafe, Nesquick, Kit Kat, Baby Formula, Vittel, Perier, etc.

- What do you think of this??

Fish & Bicycle

THE WALL STREET JOURNAL. ONLINE

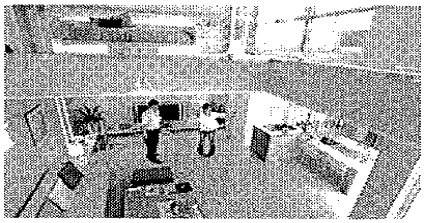
July 2, 2008

Toyota Throws More Weight Behind Its Homes Unit

By JOHN MURPHY
July 2, 2008; Page B6

KASUGAI, Japan -- **Toyota Motor Corp. has put millions of people on four wheels. Now, the global auto giant wants to put roofs over their heads, too.**

Best known for its top-selling cars like the Prius and Corolla, **Toyota is looking to apply its ecofriendly image and technical know-how to help boost sales of its small and little-known prefabricated-housing division.**



Since 1975, Toyota has been building steel-frame houses designed to withstand earthquakes and typhoons and keep out burglars.

"At Toyota, we have certain technologies that we can apply to other fields," says Senta Morioka, president of Toyota's housing operations.

At the Kasugai Housing Works in central Japan, one of Toyota's three prefab-housing factories, an assembly line of robots, conveyor belts and helmeted workers produced a steady flow of rectangular steel-framed cubicles finished with staircases, kitchen cupboards, bathtubs and toilets.

Most Toyota homes are made from six or more of these large cubicles, which are assembled -- like Legos -- on the building site. From its start on the factory floor to its final completion on site, **a Toyota home can be built in 45 days, less than half the time it takes for contractors to build a typical wooden-frame home**, Toyota says.

Like its cars, Toyota's lineup of homes is wide-ranging, with more than a dozen designs. There is the popular Smart Stage, a conservative, 1,000-square-foot, two-story home priced at about $200,000. Then there is the sleek, custom-built 2,600-square-foot Espacio Square for the Lexus set that sells for more than $800,000. Salespeople say nearly all home buyers are Toyota car owners.

Other displays focus on how Toyota's car technologies have been applied to houses, including a rustproofing process that preserves the house's steel structure for decades; a device to quiet engines that can help damp vibrations from foot traffic on the upper floors; and a single key that can be coded to open both the owner's Toyota car and Toyota home.

Toyota's home sales have risen slowly in the past three decades, peaking at just over 5,000 units in 2006 before falling to 4,600 units last year during a national slump in the housing market. This year, the company hopes to reach sales of 5,000 homes again. It has set a longer-term goal of selling 7,000 homes a year but hasn't set a specific deadline to reach that.

With sales so small and many companies trimming back unnecessary enterprises to concentrate on their core businesses, the question arises: Is this a business Toyota should be in?

Analysts say that while Toyota may realize some research benefits from its housing operations, it is hard to judge whether Toyota gains much financially from the enterprise or its other minor side businesses, including planting roof gardens, growing sweet potatoes in Indonesia and building boats.

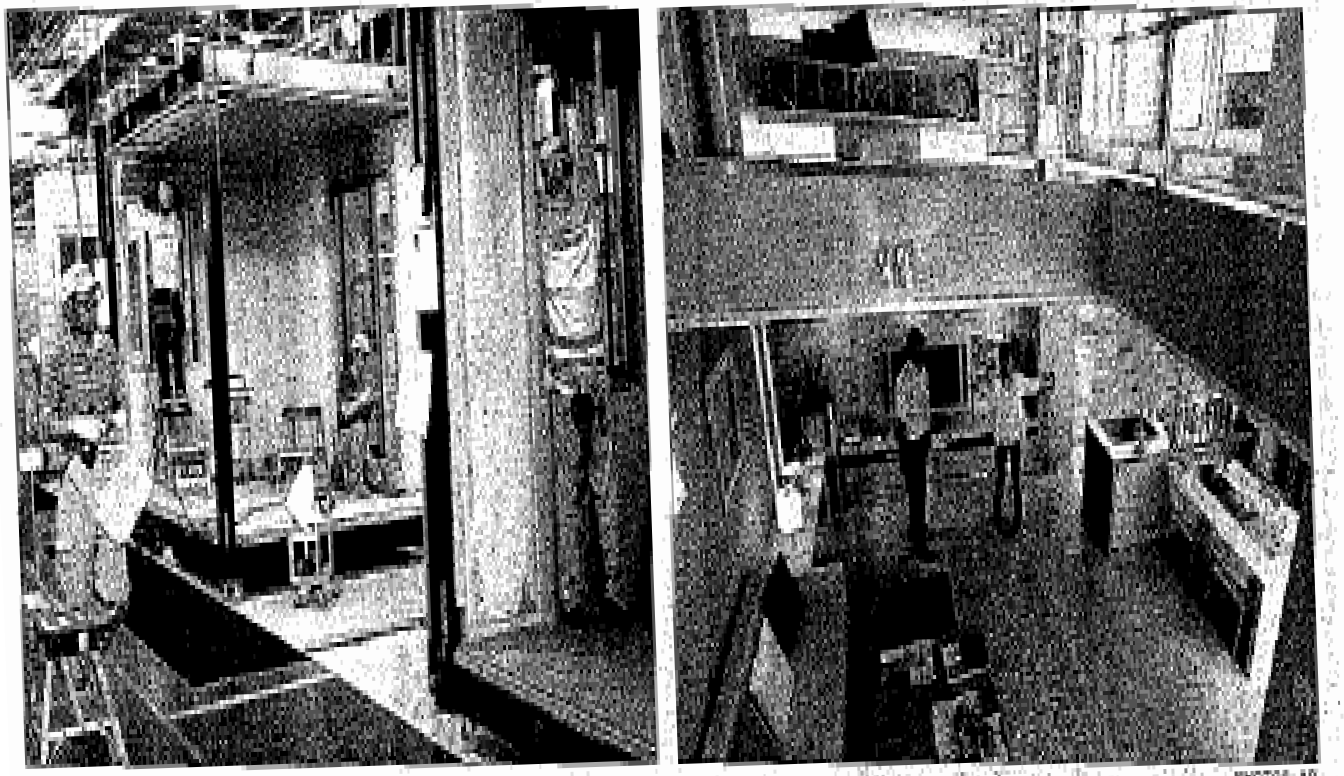
"There are lots of places to hide in Toyota, so a wasted investment is very difficult to find on a balance sheet with so many assets," says Kurt Sanger, an auto analyst for Deutsche Bank in Tokyo.

Toyota's Mr. Morioka says the business is profitable, though he declines to give details.

--Akane Ichikawa and Naoto Okamura contributed to this article.

MULTI-COUNTRY INTEGRATION (ECONOMIES OF SCALE)

Building homes on a Toyota assembly line



PHOTOS: AP

PREFAB HOMES: Workers putting the finishing touches to cubicles at a Toyota factory in Kasugai, while a couple (right) inspect a model Toyota house at a gallery in Tokyo.

Company uses car-making methods to build parts for compact Japanese houses

KASUGAI (JAPAN)

IMAGINE parts of a home, tucked with stairways, built-in closets and pink bathtubs, rolling off the assembly line just like cars.

Toyota, one of the world's biggest carmakers, is making that happen at a bustling plant in central Japan.

Kasugai Housing Works, a plant for prefabricated housing run by Toyota Motor Corp, prides itself on using the same production methods that gave the Japanese carmaker a reputation for quality and efficiency around the world.

The plant was shown to reporters on a rare tour on Wednesday.

Housing makes up less than 1 per cent of Toyota's 24 trillion yen (S$290 billion) annual sales. But company officials say the technology acquired from years of making cars is central to home-building Toyota style.

A "smart key" similar to the car key you don't need to take out of your pocket to unlock your Toyota vehicle opens and closes the front door.

A mechanism for reducing engine noise and tremors is installed under the floor to quiet upstairs stakes. Car paint-job skills deliver even scratch-resistant coating on walls.

Toyota homes are mass-produced like Toyota cars. About 85 per cent of the work on the metal-frame cubicles is finished at the plant.

The prefabricated cubicles, made to order for the customer, are stacked like toy blocks with a huge crane and topped with a roof in just six hours.

The units vary in size, with the bigger ones measuring 6m in length. An average Japanese home requires 12 units. A buyer chooses from several designs of homes, ranging from sleek modern to standard fare with tiled roofing and balcony windows.

Individual home owners visit "housing parks" in Japan, where Toyota and rival home builders have set up model homes. Customers place orders by mixing and matching layout, interiors and material to meet their needs.

Toyota, which entered the housing business in 1975, is still a minor player in the industry.

Toyota made just 4,600 homes last year, and is planning 5,000 homes this year. But it's on a roll, recording 50 straight months of on-year sales growth and is targeting 7,000 homes per year by 2010.

Toyota Housing President Teiji Tachibana acknowledged Japanese homes suffer a bad image as tiny shabby "rabbit hutches" compared to more spacious European and American homes.

But Toyota homes — which cost about 26 million yen each, average for a middle-class Japanese home — are built to endure earthquakes common in Japan and boast intelligent use of cramped space, a must for this island-nation, according to Toyota.

"We may not be able to compete in space," Mr Tachibana said. "But Toyota homes deliver top global quality."

The Toyota plant — where hammering on wood blends with the buzz of drills and robotic arms — relies on the company's prized "just-in-time" method that manufactures to order and keeps track of stock through Toyota's paper memos called "kanban", which means "signs" in Japanese.

Workers on the assembly line can at any time pull on a dangling cord to stop the assembly line — another trademark of Toyota production.

"We pursue the Toyota Way not only in Japan but globally, and we will pursue the same in housing," said Mr Senta Morioka, Toyota managing officer.

ASSOCIATED PRESS

TOYOTA QUALITY

"We may not be able to compete in space. But Toyota homes deliver top global quality."

TOYOTA HOUSING PRESIDENT TEIJI TACHIBANA

Topic 3:
Microeconomics Review:
Perfect Competition

EC 3322

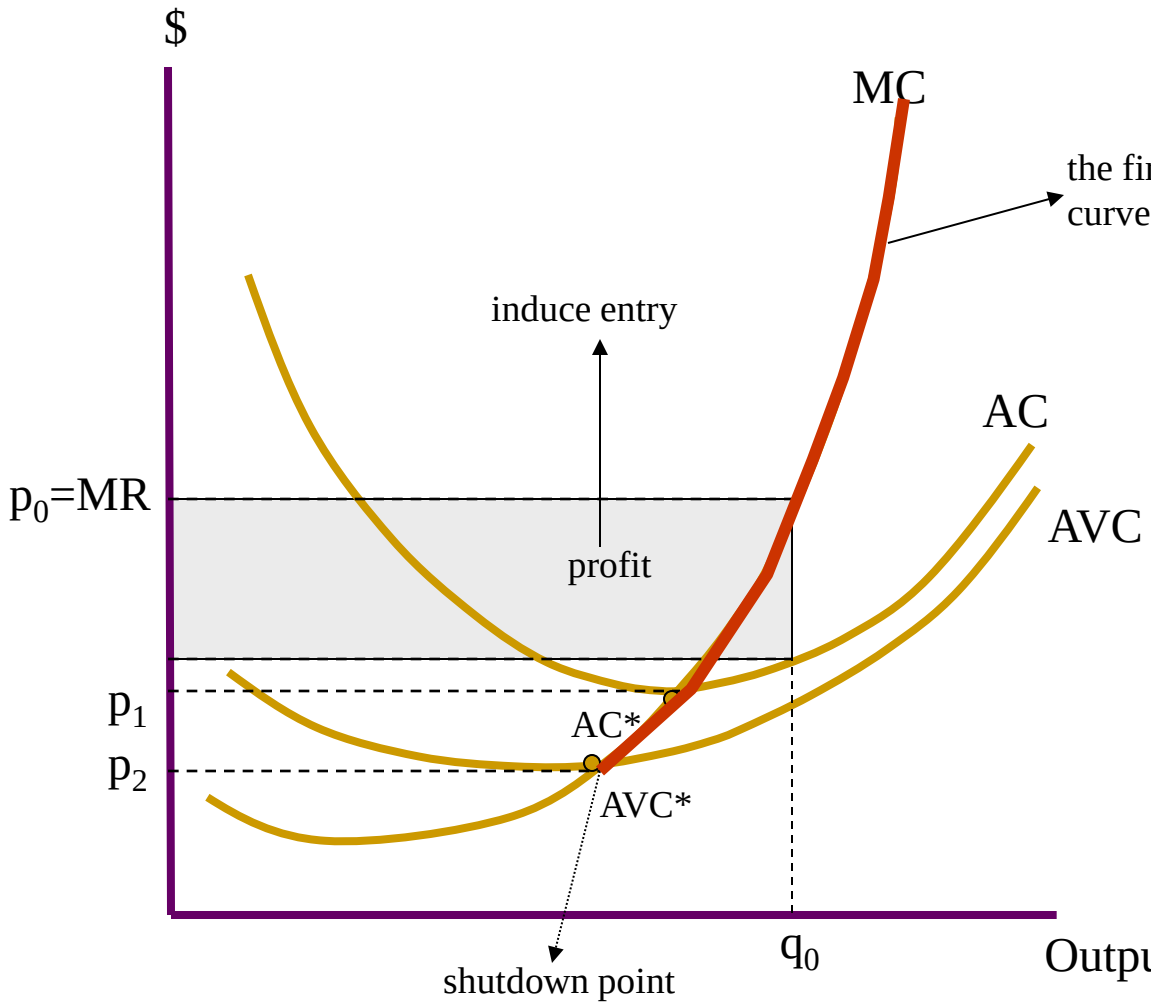
Semester I – 2008/2009

Perfect Competition

- Firms and consumers are price takers → note: we do not require many firms.
- All firms sell an identical product and consumers view the product sold by all firms as the same → indifferent.
- Perfect information → buyers and sellers have all relevant information about the market (e.g. price, quality).
- No transaction costs for participating in the market and no externalities (firms bears the full costs of production process).
- Firm can sell as much as it likes at the ruling market price. Therefore, marginal revenue equals price (p=MR).
- To maximize profit a firm *of any type* must **equate marginal revenue with marginal cost**. So in perfect competition **price equals marginal cost**

Perfect Competition

- Profits: $\pi(q) = R(q) - C(q)$



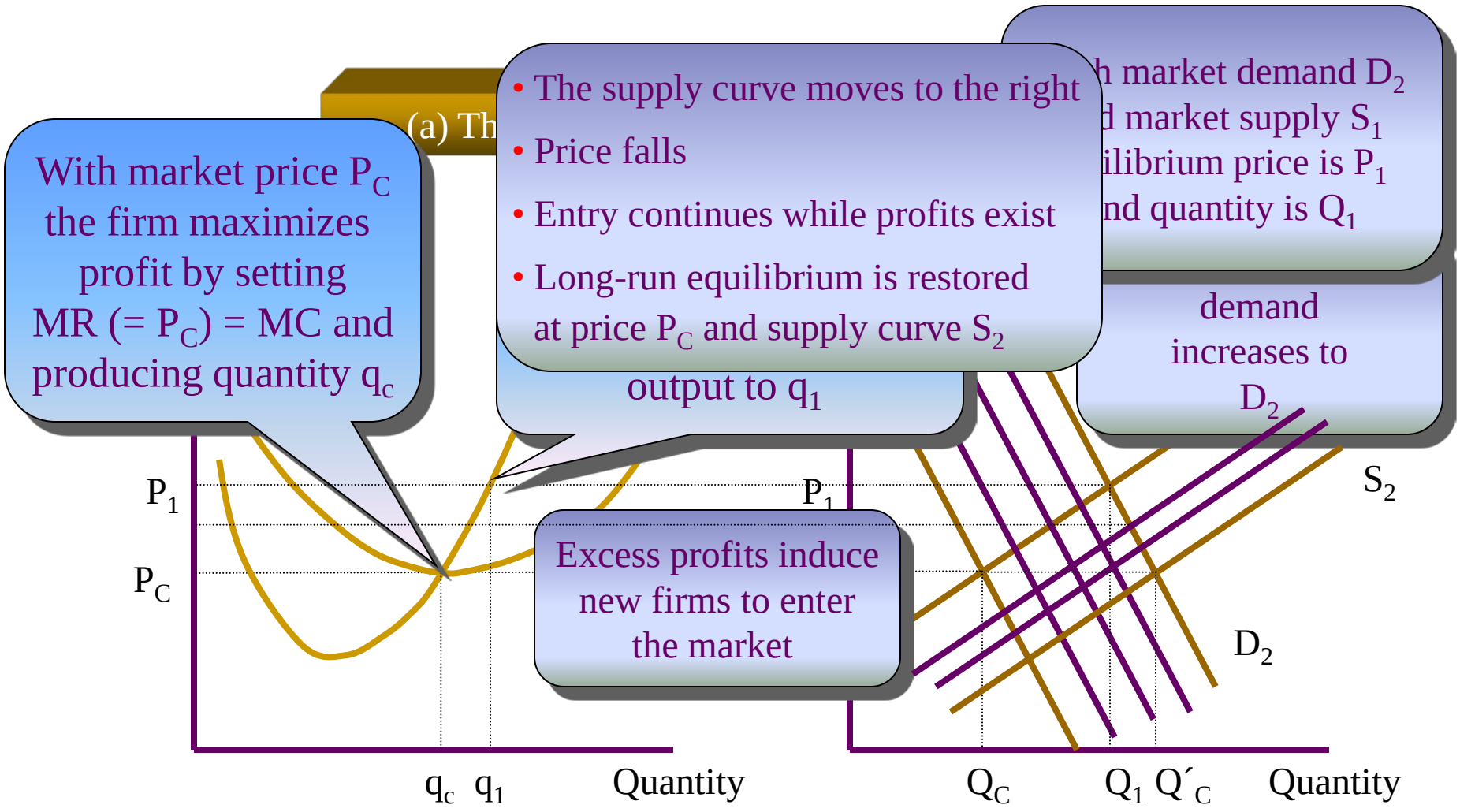
$$\pi(q) = R(q) - C(q)$$

first order condition

$$\frac{\partial \pi(q)}{\partial q} = \frac{\partial R(q)}{\partial q} - \frac{\partial C(q)}{\partial q} = 0$$

thus $MR = MC$

Perfect Competition (short-run vs. long-run)



Perfect Competition (short-run market supply curve)

- It is the *horizontal* summation of the individual firms' marginal cost curves

Example 1: Three firms

Firm 1: $q = MC/4 - 2$

Firm 2: $q = MC/2 - 4$

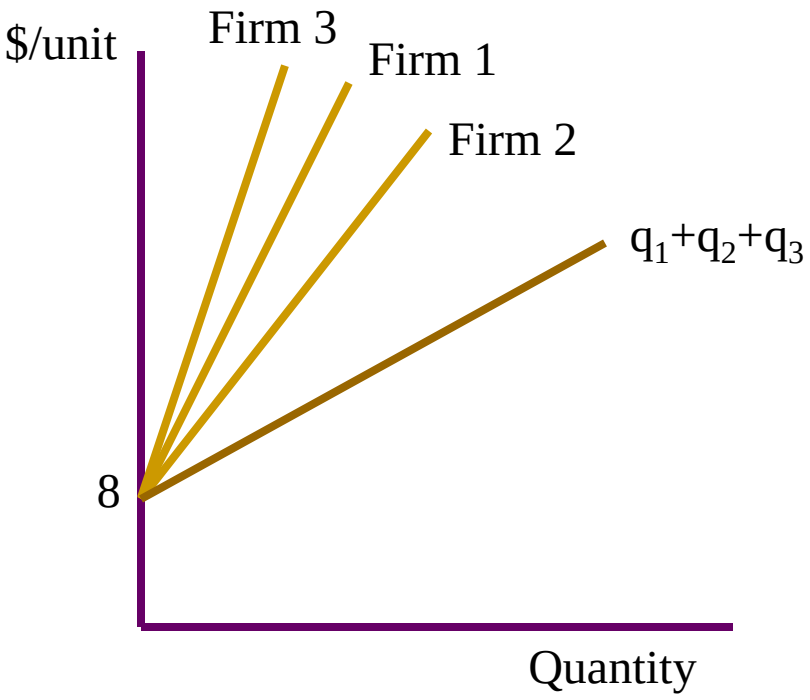
Firm 3: $q = MC/6 - 4/3$

Invert these

Aggregate: $Q = q_1+q_2+q_3$

$Q = 11MC/12 - 22/3$

$MC = 12Q/11 + 8$



Perfect Competition (long-run market supply curve)

- In the long-run: many more firms can enter the market when profit opportunity exists → LR supply curve tends to be **flat** (not always!!).

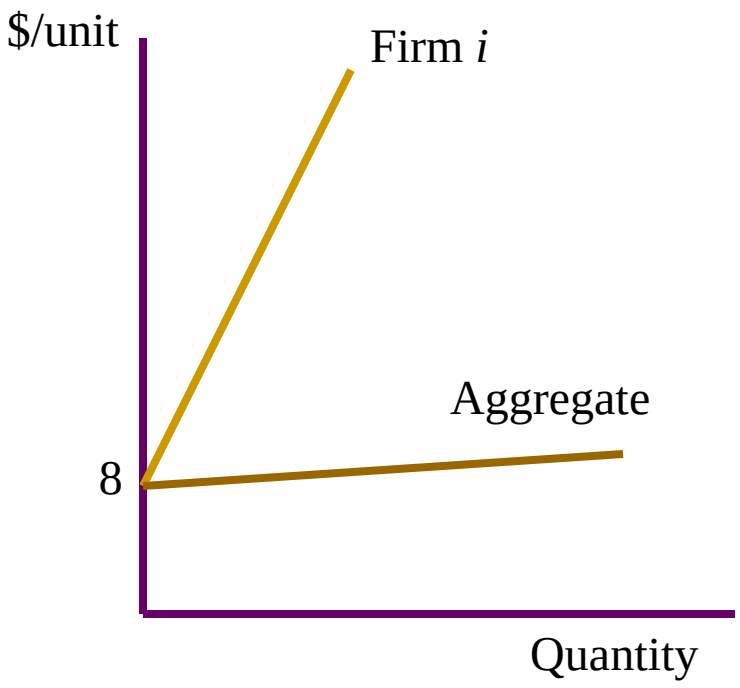
Example 2: Eighty firms

Each firm: q = MC/4 - 2

Invert these

Aggregate: Q= 80q
= 20MC - 160

MC = Q/20 + 8



Elasticities and Residual Demand Curve

- Elasticity of Demand: % change in the quantity demanded in response to a given small % change in the price.

$$\varepsilon = \frac{\partial q}{q} / \frac{\partial p}{p} = \frac{\partial q}{\partial p}\frac{p}{q}$$

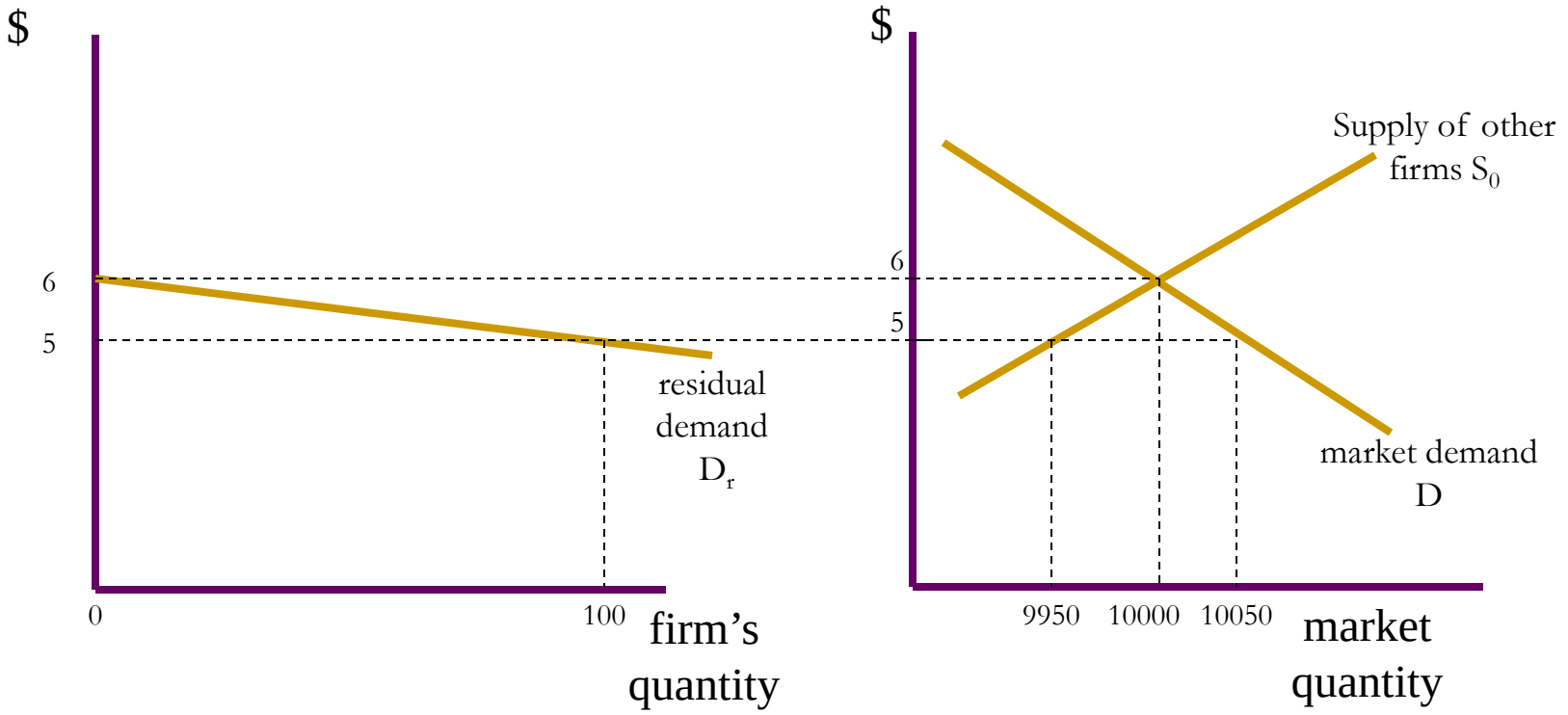
- If $\varepsilon = \begin{cases} |\varepsilon| > 1 \rightarrow \text{elastic} \\ |\varepsilon| \rightarrow \text{unit elastic} \\ |\varepsilon| < 1 \rightarrow \text{inelastic} \end{cases}$

- In general, the elasticity of demand depends on many factors such as the availability of substitute products and the taste (preference) of consumer.

- Elasticity of Supply: % change in quantity supplied in response to a given small % change in the price → similar kind of interpretation (but with + sign as the slope of the supply curve is +) → depends on e.g. the flexibility in altering the production.

Elasticities and Residual Demand Curve …

- If there are large number of firms, the demand curve faced by one firm is nearly horizontal (infinite elasticity of demand) even-though the demand curve faced by the market is downward sloping.



Elasticities and Residual Demand Curve …

- Thus, the individual demand facing firm is nearly flat → infinite elasticity → if price increases a bit, it loses all its sales → the firm is **price taker**.

- Hence, the elasticity of demand for a single firm is <u>much higher</u> than the market elasticity.

The residual demand $\rightarrow D_r(p) = D(p) - S_0(p)$

$$\frac{\partial D_r(p)}{\partial p} = \frac{\partial D(p)}{\partial p} - \frac{\partial S_0(p)}{\partial p}$$

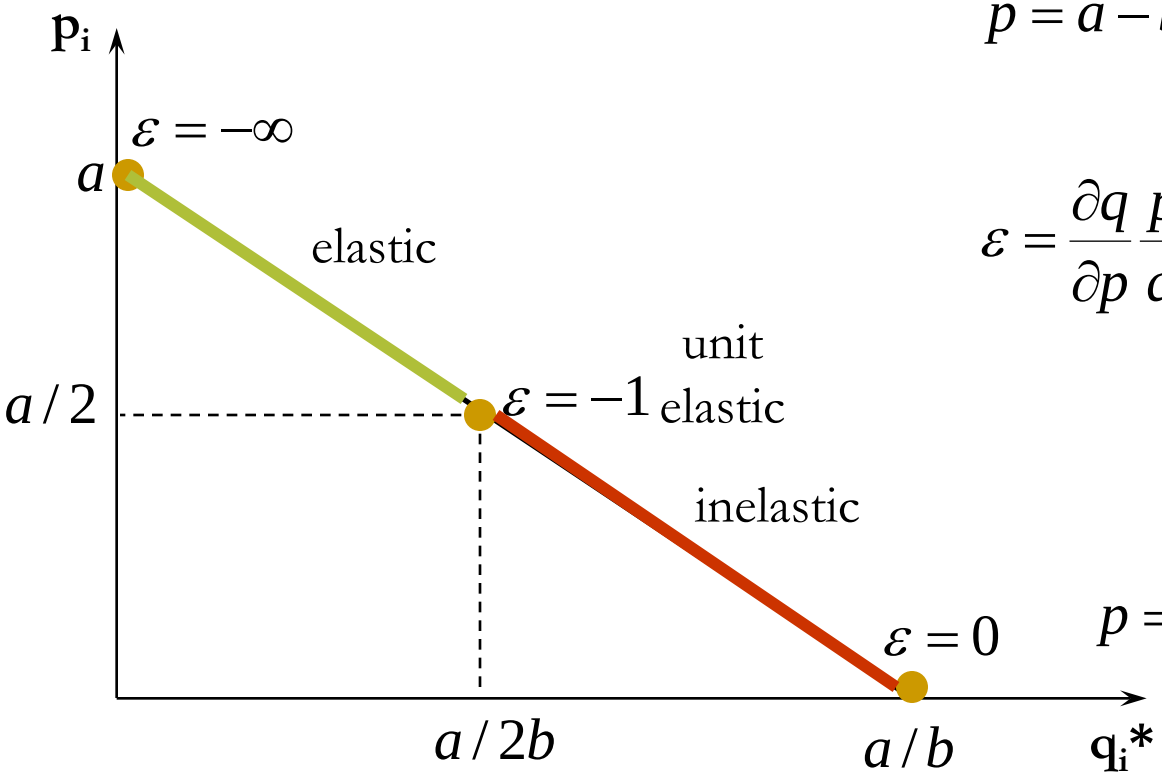
Define: $q = Q/n \rightarrow n = Q/q$ and $Q_0 = (n-1)q$

$$\frac{\partial D_r(p)}{\partial p}\frac{p}{q} = \frac{\partial D(p)}{\partial p}\frac{p}{q} - \frac{\partial S_0(p)}{\partial p}\frac{p}{q}$$

$$\underbrace{\frac{\partial D_r(p)}{\partial p}\frac{p}{q}}_{\varepsilon_i} = \frac{\partial D(p)}{\partial p}\frac{Q}{Q}\frac{p}{q} - \frac{\partial S_0(p)}{\partial p}\frac{Q_0}{Q_0}\frac{p}{q} = \underbrace{\frac{\partial D(p)}{\partial p}\frac{p}{Q}}_{\varepsilon}\underbrace{\frac{Q}{q}}_{n} - \underbrace{\frac{\partial S_0(p)}{\partial p}\frac{p}{Q_0}}_{\eta_0}\underbrace{\frac{Q_0}{q}}_{(n-1)}$$

$$\varepsilon_i = \varepsilon n - \eta_0 (n-1)$$

Elasticities (e.g. Linear Demand)



$$p = a - bq \quad \rightarrow \quad q = \frac{a}{b} - \frac{1}{b}p$$

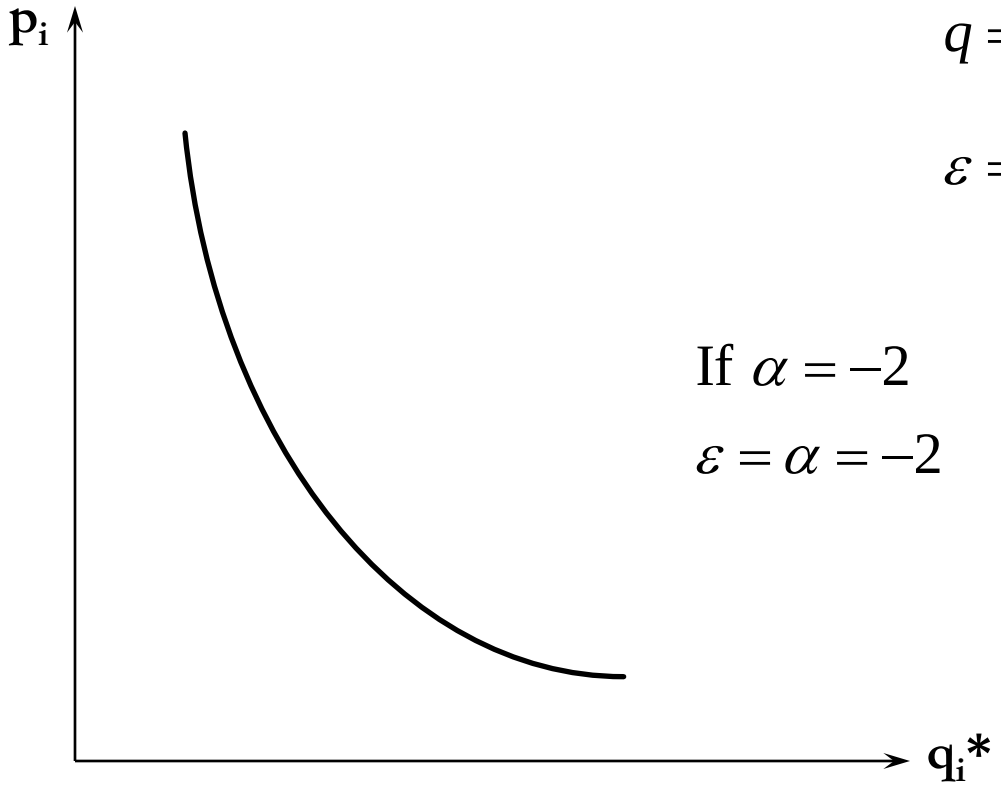
$$\varepsilon = \frac{\partial q}{\partial p}\frac{p}{q} = -\frac{1}{b}\left(\frac{p}{\frac{a}{b} - \frac{1}{b}p}\right) = -\frac{p}{a - p}$$

$$p = 0 \quad \rightarrow \quad \varepsilon = -\frac{p}{a - p} = 0$$

$$p = a/2 \quad \rightarrow \quad \varepsilon = -\frac{a/2}{a - a/2} = -1$$

$$p = a \quad \rightarrow \quad \varepsilon = -\frac{a}{a - a} = \infty$$

Elasticities (Constant Elasticity)



$$q = kp^{\alpha}$$

$$\varepsilon = \frac{\partial q}{\partial p}\frac{p}{q} = \alpha k p^{\alpha-1}\left(\frac{p}{kp^{\alpha}}\right) = \alpha$$

If $\alpha = -2$

$\varepsilon = \alpha = -2 \quad \rightarrow$ everywhere along the demand curve

Efficiency and Welfare

- Can we reallocate resources to make some individuals better off without making others worse off?

- Need a measure of well-being

  - ***consumer surplus:*** difference between the maximum amount a consumer is willing to pay for a unit of a good and the amount actually paid for that unit

  - ***producer surplus:*** difference between the amount a producer receives from the sale of a unit and the amount that unit costs to produce

  - ***total surplus*** = consumer surplus + producer surplus

Efficiency and Welfare: Illustration

The demand curve measures the willingness to pay for each unit
Consumer surplus is the area between the demand curve and the equilibrium price

The supply curve measures the marginal cost of each unit

Producer surplus is the area between the supply curve and the equilibrium price

Aggregate surplus is the sum of consumer surplus and producer surplus
The competitive equilibrium is efficient

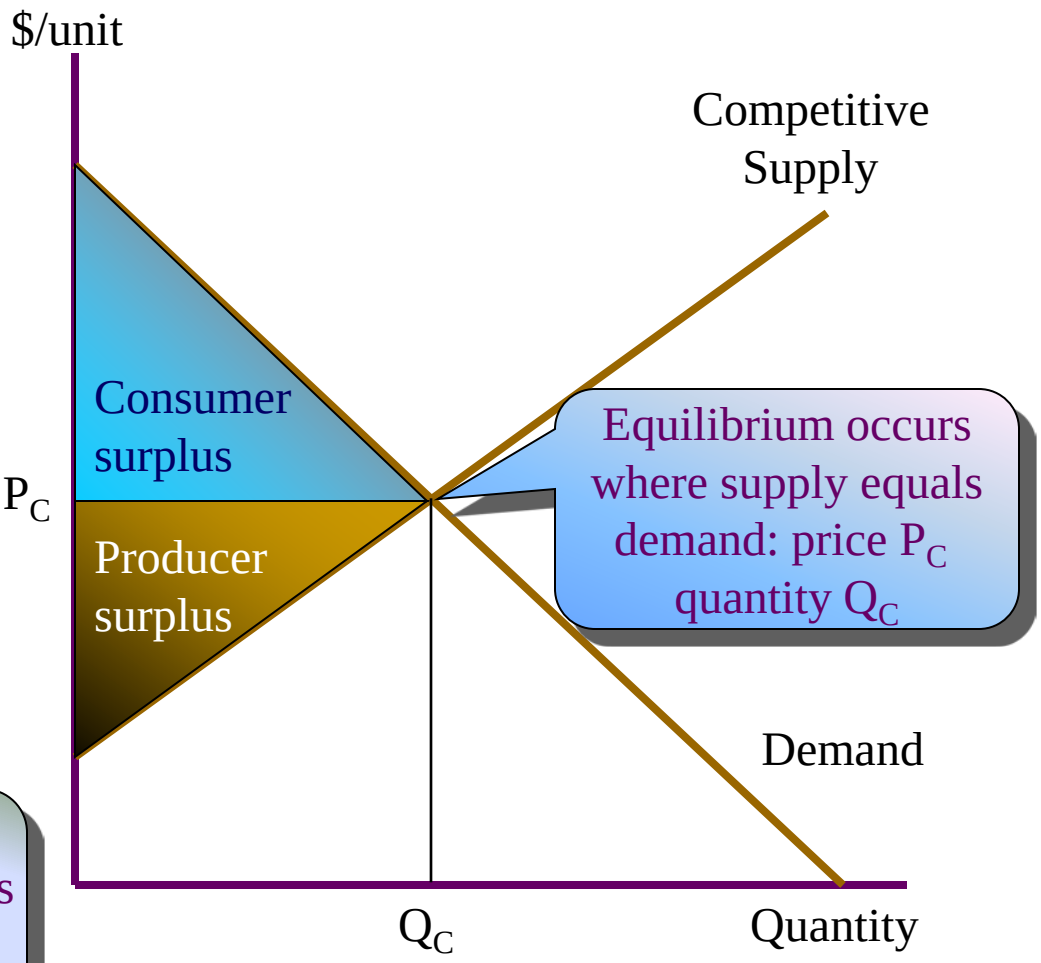


Illustration (cont.)

Assume that a greater quantity Q_G is traded

Price falls to P_G

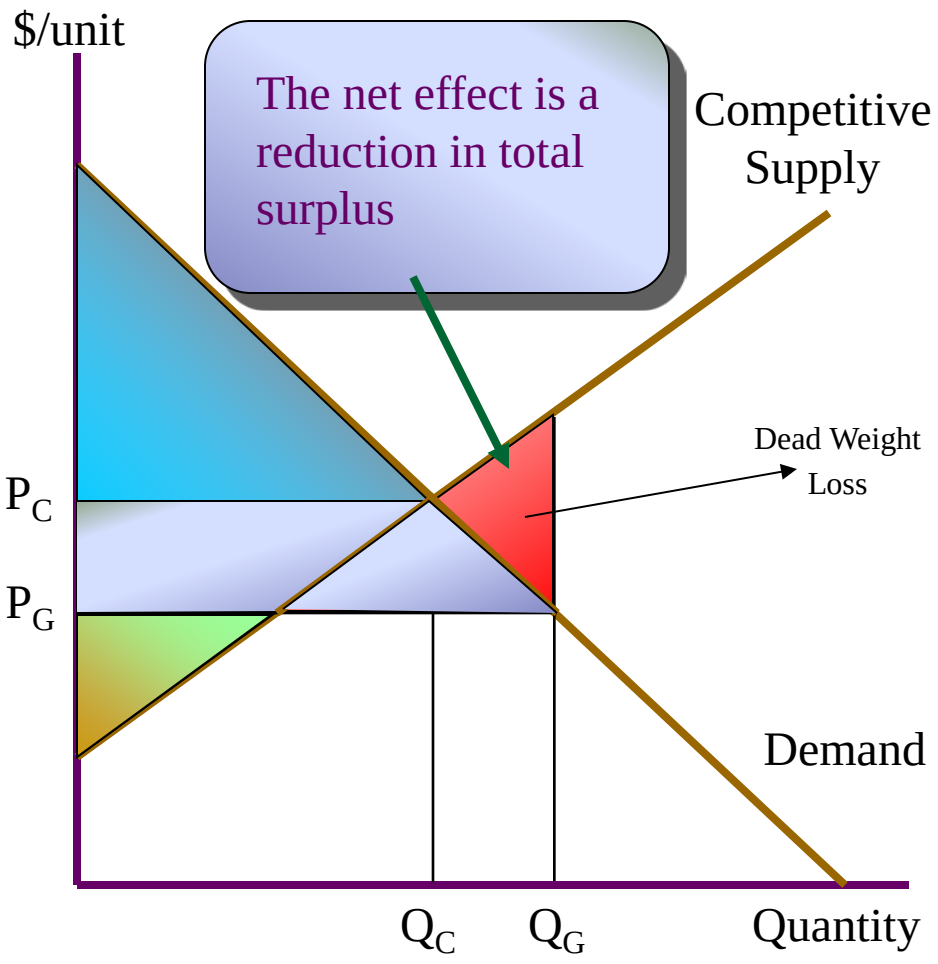
Producer surplus is now a positive part

and a negative part

Consumer surplus increases

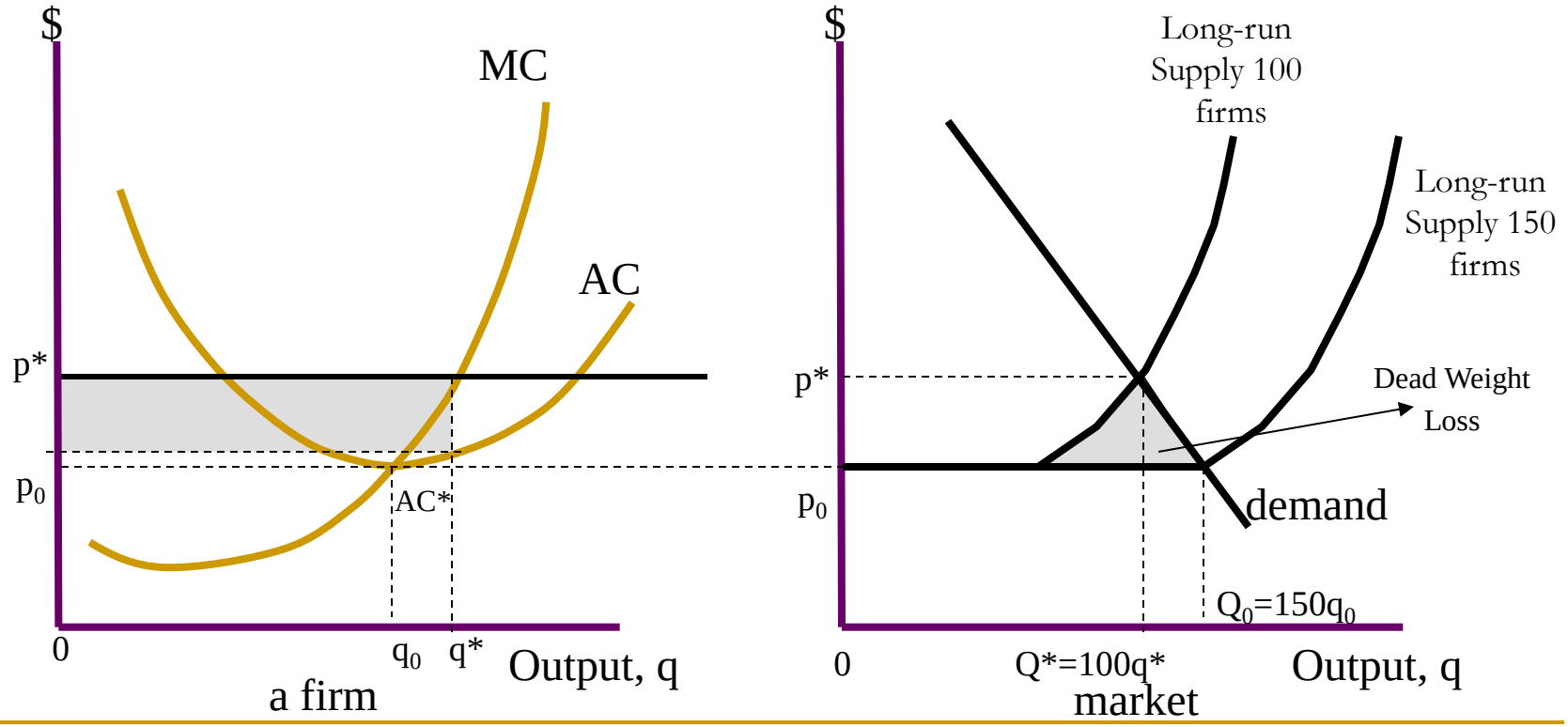
Part of this is a transfer from producers

Part offsets the negative producer surplus



Entry and Exit

- Recall → the ease of entry and exit determines the market structure.
- It is often the case that gov't put entry restriction to a market (industry) →e.g. **number of firms**, from 150 to 100 → this will increase price above the competitive level.



Barrier to Entry

- Anything that prevents a firm (an entrepreneur) from instantaneously creating a new firm in a market, e.g. setup cost (sunk cost), patent, exit cost).
- Long-run profits can only persist → when a firm has an advantage over a potential entrant → long-run barrier to entry is the cost that must be incurred by a new entrant that incumbents do not bear.
- Identification of barrier to entry (Bain 1956):
  - Absolute cost advantage.
  - Economies of scale → large capital expenditures
  - Product differentiation.

Barrier to Entry …

TABLE 3.2 **Bain's Barriers to Entry**

Industry	Scale Economy	Product Differentiation	Absolute Cost	Capital Requirement
Automobiles	3	3	1	3
Cigarettes	1	3	1	3
Liquor	1	3	1	2
Shoes	2	1–2	1	0
Soap	2	2	1	2
Steel	2	1	3	3
Tractors	3	3	1	3
Tires and tubes	1	2	1	2
Meat packing	2	2	2	0–1
Cement	2	1	1	2
Flour	1	1–2	1	0

Note: Higher scores indicate greater entry barriers.

Source: Bain (1956, 169)

Barrier to Entry …

TABLE 3.3 Bain's Overall Barriers to Entry

Industry	Overall Barriers
Automobiles	Very high
Cigarettes	Very high
Liquor	Very high
Soaps	Substantial
Steel	Substantial
Tractors	Very high
Flour	Moderate to low
Cement	Moderate to low
Meat packing	Moderate to low
Tires	Moderate to low
Rayon	Moderate to low

Note: Industries with very high barriers could elevate price 10 percent or more above competitive levels. Substantial and moderate-to-low entry barriers allow prices to be in excess of competitive levels by 7 percent and 4 percent respectively.

Source: Bain (1956, 170).