This is the first of two sets of notes on increasing returns to scale and imperfect competition as a source of trade and gains from trade (Ch11)

This set focuses on *homogeneous goods* (firms produce identical products).

The principal ideas are:

(1) trade can offer opportunities and gains even for identical countries: a pattern of comparative advantage need not exist.

(2) *efficiency gains*: by specializing in producing only one good for the whole world, each country becomes more *productive*.

(3) scale economies are associated with imperfect competition, and hence trade allows for *pro-competitive gains from trade*.

General idea behind production efficiency (productivity) gains:

In autarky, each country divides is resources between both goods, and hence the average cost of production is high (productivity is low).

With trade, each country can focus on a single good, and hence the average cost of each good falls, more is produced from a given among of factors, and a surplus is created.

General idea behind pro-competitive gains:

As we will see, increasing returns is inevitably associated with imperfect competition and prices above marginal cost.

Trade induces more competition and hence more output and lower prices.

Another way to think about this is as a classic Prisoners' Dilemma game.

Suppose that each firm makes profits of 10 in autarky. When trade is opened up, each firm has the choice between holding it quantity at the autarky level or increasing quantity.

This game has the following payoff matrix, where the first number is the profits of the home firm, and the second number is the profits of the foreign firm.

		Foreign Firm: Hold quantity	Foreign Firm: Increase quantity
Home Firm	Hold quantity	(10, 10)	(5, 12)
	Increase quantity	(12, 5)	(7, 7)

In this case the Nash equilibrium is a situation is which each firm is making a best response to the decision of its rival.

The Nash equilibrium in this case is that both firms raise their quantities, resulting in the fact that both firms are worse off relative to autarky. Profits falls from (10, 10) to (7, 7).

However, the increase in their quantities must mean that consumers are better off.

Firms costs: fixed cost plus constant marginal cost.

"Real" (in units of labor) cost function for a firm in the *X* industry

$tc = fc + mcX$

fc - fixed cost to begin production
mc - constant marginal cost
X - output

$ac = fc/X + mc$

Average cost function
Average cost is decreasing in *X*
Average cost always > marginal cost

Figure 11.1

Figure 11.1

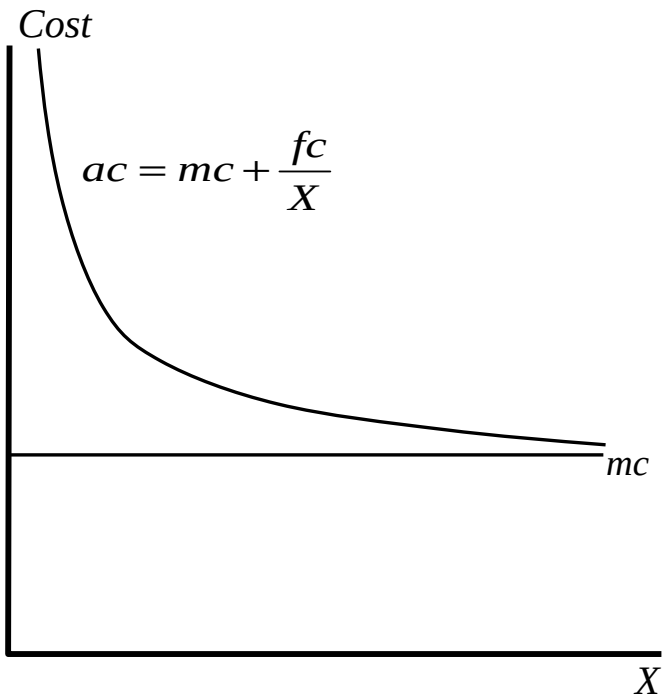
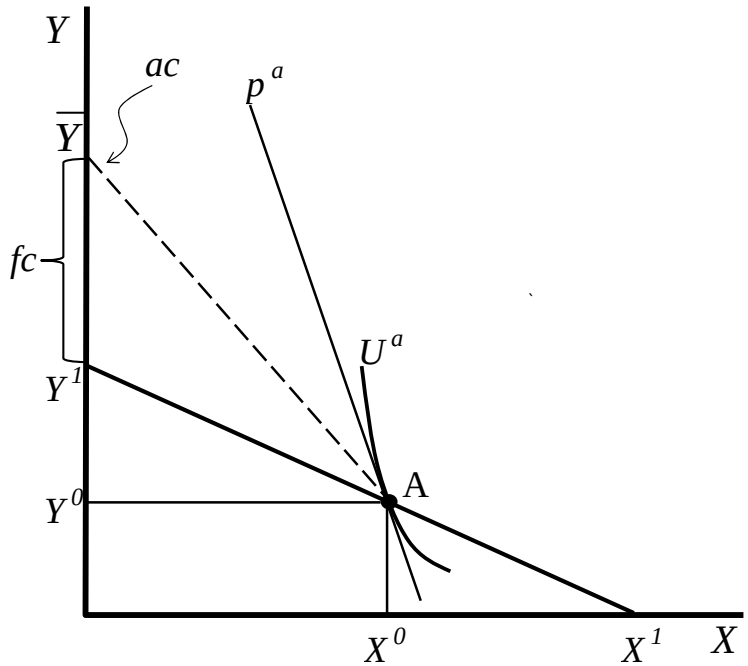


Figure 11.2



Because average cost is always greater than marginal cost, it is not possible to have a perfectly competitive equilibrium ($p = mc$).

This would imply that firms are losing money.

And if firms are assumed to be price takers, any price $p > mc$ would induce firms to expand output to infinity.

Therefore, the assumption of price-taking behavior is inconsistent.

Equilibrium must involve large firms with market power.

Assume $Y = L_y$, $L_x = fc + mcX$ and that $L = L_x + L_y$

Figure 11.2

For a given amount of X output, the minimum price which allows a monopoly producer to break even is average cost, ac.

$$ac_x = \frac{L_x^0}{X^0} = \frac{(\bar{L} - L_y^0)}{X} = \frac{(\bar{Y} - Y^0)}{X^0} \qquad (11.2)$$

This is shown in Figure 11.2 by a cord connecting the production point A to the Y intercept of the production frontier.

1. Derive the marginal revenue function for a monopolist

2. Show the relationship between the monopoly equilibrium and a production tax for a closed economy.

Marginal Revenue: The revenue derived from selling one more unit. For a perfectly competitive firm, marginal revenue = price (since price is fixed from the firm's point of view).

For a monopolist, price must be lowered on <u>all units</u> in order to sell more. So marginal revenue is less than price: price - loss of revenue on other sales.

Revenue for a Cournot firm i and selling in country j is given by the price in j times quantity of the firm's sales. Price is a function of all firms' sales.

$$R_{ij} = p_j(X_j)X_{ij} \quad \text{where } X_j \text{ is total sales in market j } X_j = \sum_i X_{ij} \quad (11.3)$$

Cournot conjectures imply that $\partial X_j/\partial X_{ij} = 1$; that is, a one-unit increase in the firm's own supply is a one-unit increase in market supply.

Marginal revenue is then given by the derivative of revenue in (11.3) with respect to firm i's output (sales) in j.

$$\frac{\partial R_{ij}}{\partial X_{ij}} = p_j + X_{ij}\frac{\partial p_j}{\partial X_j}\frac{\partial X_j}{\partial X_{ij}} = p_j + X_{ij}\frac{\partial p_j}{\partial X_j} \qquad \text{since } \frac{\partial X_j}{\partial X_{ij}} = 1 \quad (11.4)$$

Now multiple and divide the right-hand equation by total market supply and also by the price.

$$\frac{\partial R_{ij}}{\partial X_{ij}} = p_j + X_{ij}\frac{\partial p_j}{\partial X_j} = p_j + p_j\frac{X_{ij}}{X_j}\left[\frac{X_j}{p_j}\frac{\partial p_j}{\partial X_j}\right] \qquad (11.5)$$

The term in square brackets in (11.5) is just the inverse of the price elasticity of demand, defined as the proportional change in market demand in response to a given proportional change in price.

This is negative, but to help make the markup formula clearer we will denote minus the elasticity of demand, now a positive number, by the Greek letter $\eta > 0$. We can then write (11.5) as

$$\frac{\partial R_{ij}}{\partial X_{ij}} = p_j\left[1 - \frac{X_{ij}}{X_j}\frac{1}{\eta_j}\right] \qquad \eta_j \equiv -\left[\frac{p_j}{X_j}\frac{\partial X_j}{\partial p_j}\right] \quad (\textit{elasticity of demand}) \tag{11.6}$$

The term X_{ij}/X_j in (11.6) is just firm i's market share in market j, which we can denote by s_{ij} . Then marginal revenue = marginal cost is given by:

$$mr_{ij} = p\left[1 - \frac{s_{ij}}{\eta_j}\right] = mc_i \tag{11.7}$$

Marginal revenue in Cournot competition turns out to have a fairly simple form as shown in (11.7). The term s_{ij}/η_j is referred to as the "markup".

Pro-Competitive Gains from Trade: Consider first autarky, and assume one X producer in each of two identical countries.

In equilibrium, producers in both sectors equate marginal revenue to marginal cost (marginal cost in Y equals price).

$$\frac{p_x(1 - 1/\eta_x)}{p_y} = \frac{mc_x}{mc_y} = MRT < \frac{p_x}{p_y}$$

This looks very much like a production tax on *X*. Closed economy equilibrium with the *X* sector monopolized.

Figure 11.3: autarky equilibrium at point A, utility level U^a.

Figure 11.3

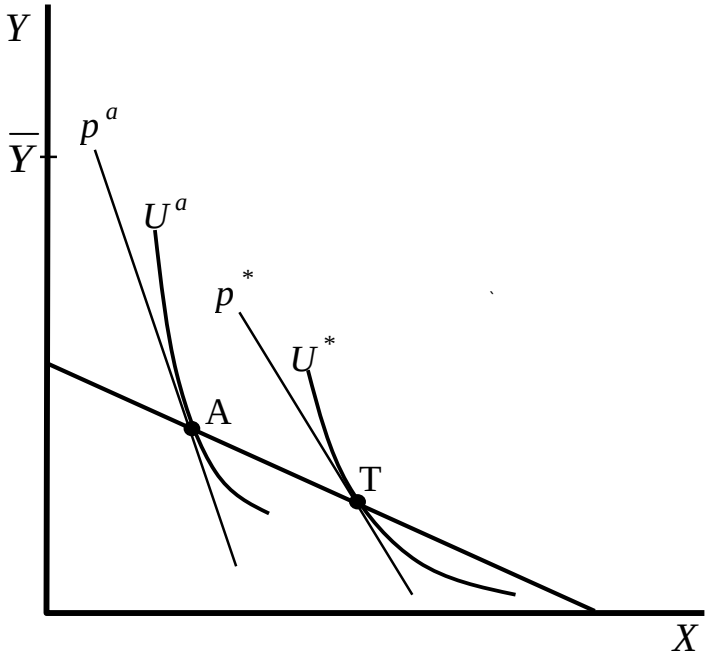
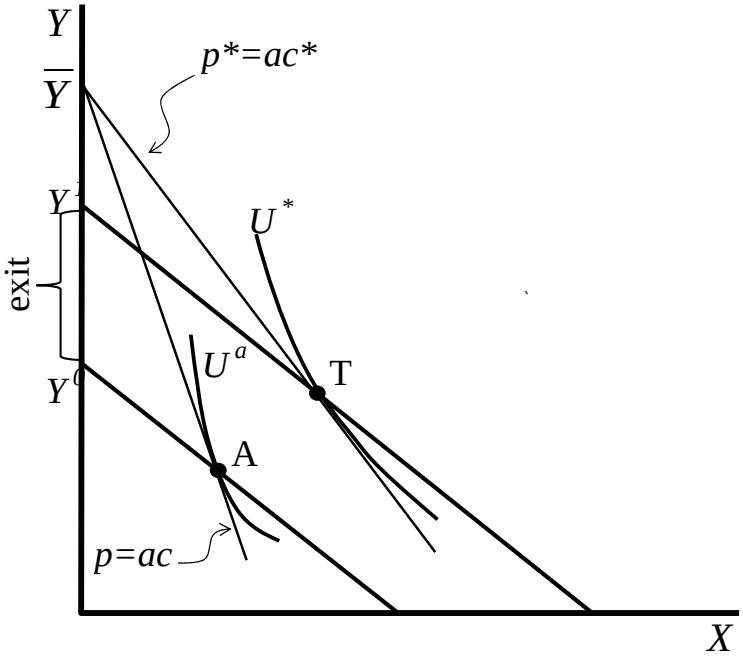


Figure 11.4



Now allow free trade between the two identical countries:

$$\frac{p_x^*(1 - 1/(2\eta_x))}{p_y^*} = \frac{mc_x}{mc_y} = \frac{p_x^a(1 - 1/\eta_x)}{p_y^a} \qquad \frac{p_x^*}{p_y^*} < \frac{p_x^a}{p_y^a}$$

Figure 11.3. Trade leads to an expansion in X output and a fall in price for both identical countries. Trade production/consumption at T.

The average cost of producing X falls, improving productivity and efficiency.

This leads to a welfare increase to U^* in Figure 11.3.

Free trade may results in no *net* trade, but there may be considerable *gross* trade as firms invade one another's markets.

Free trade results in:

(1) higher outputs per firm and lower average cost

(2) lower consumer price

(3) welfare gain

1. Suppose that there is free entry an exit of firms, so that the number of firms adjusts so that there are zero pure profits in equilibrium.

2. Put two identical countries together as before. All firms will have an incentive to expand as earlier, but now the "prisoners' dilemma will mean that all firms now make losses.

2. Trade will have the "rationalizing" effect of reducing the number of firms in each country individually, but leaving the world economy with more firms in the end (more competition for the consumers).

   Example, Figure 11.4: each country has 10 firms in autarky.

   competition due to trade forced out 3 firms in each country.

   each country has 7 firm in free trade, but there are now 14 firms in competition with each other.

1. With increasing-returns-to-scale technologies, trade and gains from trade can arise even between two identical economies. We could refer to this as "non-comparative-advantage trade".

2. There are several sources of gains from trade in the presence of scale economies and imperfect competition (initially distorted economies).

(1) Pro-competitive effects lead firm to expand output toward a first-best when the market expands through trade, reducing the distortion between price and marginal cost.

(2) Individual firms move down their average cost curves, leading to an efficiency (productivity) effect.

(3) Gains may also be captured in the form of the exit of some firms, therefore freeing up the resources that were used in fixed costs.

WORLD RANKING OF MANUFACTURERS
YEAR 2009

Rank	GROUP	Total	CARS	LCV	HCV	HEAVY BUS
	Total	**60,499,159**	**51,075,480**	**7,817,520**	**1,305,755**	**300,404**
1	TOYOTA	7,234,439	6,148,794	927,206	154,361	4,078
2	G.M.	6,459,053	4,997,824	1,447,625	7,027	6,577
3	VOLKSWAGEN	6,067,208	5,902,583	154,874	7,471	2,280
4	FORD	4,685,394	2,952,026	1,681,151	52,217	
5	HYUNDAI	4,645,776	4,222,532	324,979		98,265
6	PSA	3,042,311	2,769,902	272,409		
7	HONDA	3,012,637	2,984,011	28,626		
8	NISSAN	2,744,562	2,381,260	304,502	58,800	
9	FIAT	2,460,222	1,958,021	397,889	72,291	32,021
10	SUZUKI	2,387,537	2,103,553	283,984		
11	RENAULT	2,296,009	2,044,106	251,903		
12	DAIMLER AG	1,447,953	1,055,169	158,325	183,153	51,306
13	CHANA AUTOMOBILE	1,425,777	1,425,777			
14	B.M.W.	1,258,417	1,258,417			
15	MAZDA	984,520	920,892	62,305	1,323	
16	CHRYSLER	959,070	211,160	744,210	3,700	
17	MITSUBISHI	802,463	715,773	83,319	3,371	
18	BEIJING AUTOMOTIVE	684,534	684,534			
19	TATA	672,045	376,514	172,487	103,665	19,379
20	DONGFENG MOTOR	663,262	663,262			
21	FAW	650,275	650,275			
22	CHERY	508,567	508,567			
23	FUJI	491,352	440,229	51,123		
24	BYD	427,732	427,732			
25	SAIC	347,598	347,598			
26	ANHUI JIANGHUAI	336,979	336,979			
27	GEELY	330,275	330,275			
28	ISUZU	316,335		18,839	295,449	2,047
29	BRILLIANCE	314,189	314,189			
30	AVTOVAZ	294,737	294,737			
31	GREAT WALL	226,560	226,560			
32	MAHINDRA	223,065	145,977	77,088		
33	SHANGDONG KAIMA	169,023	169,023			
34	PROTON	152,965	129,741	23,224		
35	CHINA NATIONAL	120,930		120,930		
36	VOLVO	105,873		10,032	85,036	10,805
37	CHONGQING LIFAN	104,434	104,434			
38	FUJIAN	103,171	103,171			
39	KUOZUI	93,303	88,801	2,624	1,878	
40	SHANNXI AUTO	79,026		79,026		
41	PORSCHE	75,637	75,637			
42	ZIYANG NANJUN	72,470	72,470			

Table I MES estimates (in thousand units p.a.) for major manufacturing operations

Source	Year	Foundry/ forging	Pressing	Powertrain	Final assembly
Maxcy and Silberston	1958	–	1,000	500[a]	100
Toyota	1960	180-360[b]	480-600	120-240[c]	96-180
Pratten	1971	1,000	500	250	300
White	1971	"Variable"	400	260	200-250
Rhys	1972	200	2,000	1,000	200
McGee	1973	2,000	–	–	–
Ford UK	1974/5	2,000	–	–	300
CPRS	1975	100	–	500	250
Euroeconomics	1975	2,000	2,000	1,000	250

Notes:

[a] This is for machining only; [b] Forging only; [c] Machine fabricating

Sources:

Adapted from Central Policy Review Staff (1975, p. 16); *Euro-Economics* (1975); Ford UK (1975); McGee (1973); Marsden *et al.* (1985, Table 4, p. 43); Maxcy and Silverston (1959, pp. 84-6); Odaka *et al.* (1988, p. 63 (cite Toyota figures)); Pratten (1971, p. 243); Rhys (1972); White (1971)

second, MES levels decline, the further "downstream" a process is.

The first trend can be attributed to the fact

possible, related, factors giving rise to diseconomies: first, "imperfect expansibility of the management factor", i.e. management is less

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Table II Total production cost penalties from sub-optimal scale (White's estimates)

Level of production	50,000	100,000	200,000	400,000	800,000
Total cost-penalty (%)	20	10-15	3-5	0	–1

Source: White (1971)

Table III Total production cost penalties from sub-optimal scale (Waverman and Murphy's estimates)

Size of plant (% of MES)	100	80	60	30	10
Cost penalty	0	3	6.8	19.5	34.5

Source: Waverman and Murphy (1990)