International Economics

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Lecture 3

The Heckscher-Ohlin Theory

- Factor Abundance, Factor Intensities
- The Heckscher-Ohlin (H-O) Theorem
- The Factor-Price Equalization Theorem
- The Stolper-Samuelson Theorem
- The Rybczynski Theorem
- Testing the H-O Model Leontief Paradox

Questions

1. What if the technology available was the same for all countries. Would there be any reason to trade? Is there any basis for comparative advantage?

2. Where does comparative advantage come from and why does it change?

- Why does Japan have a comparative advantage in high technology industries?
- What has enabled Japan to shift its comparative advantage from textiles (in the years after WWII) to high technology manufacturing products?

The H-O Theorem - aims to answer the question 2

Questions

3. How does international trade affect the differences in relative factor prices between nations? How do factor prices vary across countries?

For example: How does trade affect the gap between relative labour wages in Poland and relative labour wages in Germany?

4. How does trade affect the distribution of income among factors of production within nations? Does trade increase labour's share of the income or does it shift the distribution towards the owners of capital?

The Factor-Price Equalization Theorem - answers the question 3

The Stolper-Samuelson Theorem - answers the question 4

- **Eli F. Heckscher** (1919), *The Effect of Foreign Trade on the Distribution of Income* [in Swedish], Ekonomisk Tidskrift, 21(2), pp 1-32.; reprinted in *Readings in the theory of international trade*, Homewood, IL: Irwin, 1950, pp 272-300.

- **Bertil G. Ohlin** (1933), *Interregional and International Trade*, Cambridge, MA: Harvard University Press.

The Heckscher-Ohlin model - assumptions

- Two countries, two homogenous tradeable consumption goods and two homogenous nontradeable factors of production (capital *K*, labour *L*).

- Factor endowments fixed in each country but different across countries (countries differ in their relative factor endowments), perfect factor mobility within a country but not between countries.

- Identical, linearly homogenous technologies across countries (constant returns to scale, with diminishing marginal returns to inputs).

The Heckscher-Ohlin model - assumptions

- The production functions differ in relative usage of capital and labour – one good is capital intensive, another good is labour intensive (differences in factor intensity across sectors).

- Identical and homothetic (homogenous) preferences in both countries (the assumption eliminates the possibility that comparative advantage can be based on differences in demand behaviour).

- Perfect competition (perfect price flexibility, fully employed factors).

- Free trade and insignificant transport costs.

The H-O model departs from Ricardian model in two fundamental ways

- It assumes existence of second factor (capital).
- The model rests on the notion of identical production functions in both countries.

Countries are identical in every respect except one: they have different endowments of factors, i.e. of labour and capital.

Trade is based on differences in supplies of capital and labour not on international technological differences.

Factor Abundance

What does factor abundance mean?

Factor abundance is measured relatively: by the ratio between the amount of capital and amount of labour or by the ratio between factor prices.

Definitions: Country A versus country B is capital abundant if

- *physical definition*: $\left(\frac{K}{L}\right)_A > \left(\frac{K}{L}\right)_B$ (the capital-labour ratio in A greater than it is in B – country A is relatively capital-abundant or labour-scarce),
- *price definition*: under autarky $\left(\frac{w}{r}\right)_A > \left(\frac{w}{r}\right)_B$.

K - total amount of capital, L - total amount of labour, w- wage rate, r - rental rate of capital

Example 1. (Factor abundance)

Consider two factors: labour and land

assumption: labour force = population; land = area of a country

Country	Area (sq km)	Polulation	Population density
Belgium	30,528	11,007,020	360.6
China	9,640,821	1,339,724,852	138.96
Germany	357,021	81,799,600	229.1
Poland	312,685	38,186,860	122.1
Portugal	92,090	10,647,763	115.6
Russia	17,075,400	142,905,208	8.37
Spain	504,030	46,030,109	91.3
Turkey	783,562	73,722,988	94.1
USA	9,826,675	312,355,000	31.8

- Belgium is the most labour-abundant country in the group.
- China versus Belgium and Germany is relatively scarce in labour.
- Poland versus Portugal is relatively scarce in land (or relatively labour-abundant).
- Poland versus Belgium is relatively scarce in labour.

Factor Intensities

Let a country produces good X and good Y.

Total amount of capital is divided into two sectors:

$$K = K_X + K_Y,$$

where

K_X - an amount of capital used for production of good X,

K_Y - an amount of capital used for production of good Y.

Total amount of labour is $L = L_X + L_Y$.

Factor Intensities

Good X is relatively **capital-intensive** and good Y is relatively **labour-intensive** if:

1. The capital-labour ratio used in production of good X is higher than the capital-labour ratio used in production of good Y:

$$\frac{K_X}{L_X} > \frac{K_Y}{L_Y} \qquad \text{or} \qquad \frac{a_{KX}}{a_{LX}} > \frac{a_{KY}}{a_{LY}}$$

where

$$a_{KX} = \frac{K_X}{X}, \qquad a_{LX} = \frac{L_X}{X}, \qquad a_{KY} = \frac{K_Y}{Y}, \qquad a_{LY} = \frac{L_Y}{Y}.$$

Factor Intensities

2. The percentage of total capital that is used in production of good X is bigger than the percentage of total labour that is used for production of good X

$$\frac{K_X}{K} > \frac{L_X}{L} \qquad \text{or} \qquad \text{relatively} \qquad \frac{L_Y}{L} > \frac{K_Y}{K}$$

Graphical illustration

Total capital $K \rightarrow 100\%$

Total labour $L \rightarrow 100\%$

Factor Intensities

3. The share of the cost of capital in the price of good X $(a_{KX} \cdot r/p_X)$ is bigger than the share of the cost of capital in the price of good Y $(a_{KY} \cdot r/p_Y)$.

$$\frac{a_{KX} \cdot r/p_X}{a_{LX} \cdot w/p_X} > \frac{a_{KY} \cdot r/p_Y}{a_{LY} \cdot w/p_Y}$$

where r is the rental rate, w is the wage rate, p_X is the price of good X, p_Y is the price of good Y.

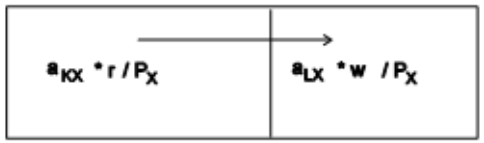
Factor Intensities

price of good = rental rate × number of units of capital
+ wage rate × number of units of labour

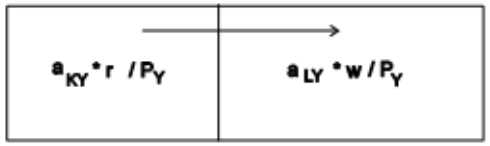
The price of good X: $p_X = a_{KX} \cdot r + a_{LX} \cdot w$,

The price of good Y: $p_Y = a_{KY} \cdot r + a_{LY} \cdot w$.

Graphical illustration



Price of X → 100%



Price of Y → 100%

Example 2. (Factor intensity)

Let's consider a country with fixed total amount of capital and labour that produces good *X* and *Y*.

Assumption: Total capital = 1500 units; Total labour = 900 units

	Good *X*	Good *Y*
Capital (*K*)	1000	500
Labour (*L*)	500	400
Capital-Labour ratio	**1000/500=2**	**1.25**
Factor intensity	Capital-intensive	Labour-intensive
Capital/Total capital	**1000/1500=0.67**	0.33
Labour/Total labour	500/900=0.56	**0.44**
Factor intensity	Capital-intensive	Labour-intensive

	Good *X*	Good *Y*
Total amount of a good	100	200
Price of a good	28	10
Rental rate of capital (*r*)	0.8	0.8
Wage rate (*w*)	4	4
Share of the cost of capital in the price of good	**0.29**	0.2
Share of the cost of labour in the price of good	0.71	**0.8**
Factor intensity	Capital-intensive	Labour-intensive

$$a_{KX} = \frac{1000}{100} = 10, \quad a_{LX} = \frac{500}{100} = 5,$$

$$a_{KY} = \frac{500}{200} = 2.5, \quad a_{LY} = \frac{400}{200} = 2$$

To obtain r and w one's must solve the following system of linear equations:

$$\begin{cases} p_X = a_{KX} \cdot r + a_{LX} \cdot w \\ p_Y = a_{KY} \cdot r + a_{LY} \cdot w \end{cases} \rightarrow \begin{cases} 28 = 10 \cdot r + 5 \cdot w \\ 10 = 2.5 \cdot r + 2 \cdot w \end{cases} \rightarrow \begin{cases} r = 0.8 \\ w = 4 \end{cases}$$

$$\frac{a_{KX} \cdot r / p_X}{a_{LX} \cdot w / p_X} = \frac{0.29}{0.71} = 0.41 \; > \; \frac{a_{KY} \cdot r / p_Y}{a_{LY} \cdot w / p_Y} = \frac{0.2}{0.8} = 0.25$$

The Heckscher-Ohlin Model

- Comparative advantage is determined by the interaction of factor-abundances of nations and factor-intensities of products.

- H-O model suggests that each nation has a comparative advantage in the good that intensively uses the abundant factor.

The Heckscher-Ohlin Model

- **The Heckscher-Ohlin Theorem:** Under the H-O assumptions, each country will export the good that uses relatively intensively its relatively abundant factor of production.

- The countries that have abundant supplies of agricultural land tend to be exporters of grains and food.
- Countries with abundant endowments of low-skilled labour tend to export labour-intensive goods (clothing, footwear, consumer electronics).

As a result of trade in each country

- The production of the good in which a country has a comparative advantage will increase.
- The production of the good that uses the country's abundant resource will increase, while the production of the good that uses the country's scarce resource will decrease.
- As the production of the good using the abundant resource intensively increases, demand for that resource will increase, so the demand for the scarce resource, but by a smaller amount.
- As the production of the good that uses the scarce resource intensively decreases, both abundant and scarce resources will be released, but relatively more of the scarce resource will be released than the abundant resource.

Comparative advantage can change for a nation if either

- its relative factor abundance changes compared to other nations

or if

- technological change creates a change in the factor intensity properties of particular products.

The Factor-Price Equalization Theorem (FPE)

- Under the H-O assumptions, free trade in goods tends to equalize relative factor prices across national borders, so long as economies produce both goods.

Relative price of capital - the price of capital relative to the price of other factor in a country.

The Factor-Price Equalization Theorem (FPE)

- Free trade tends to rise the relatively price of capital in a capital abundant country, because capital is intensively used in the expanding capital intensive export industries. The increasing demand for capital, raising its relative price.

- At the same time, the relative price of capital tends to fall in a labour abundant country. The autarky price of capital in a labour abundant country is high because it is a capital scarce country. As trade begins, this country begins to rely less on its own production of capital-intensive goods and instead imports cheaper capital intensive good. Capital intensive sector contracts, the relative price of capital falls.

- In theory this pattern continues until the relative price of capital in both countries reach equality at some level between the two autarky equilibria.

Factor-Price Equalization

- is a tendency, not an outcome, because of market imperfections (trade restrictions, positive transport costs, not identical technologies, imperfect competition);

- talks only about relative prices and wages, not absolute prices and wages (the relative are equal even though the absolute prices are different);

- says that relative factor prices will tend towards equality between nations, not within nations (trade will not cause the wage of scarce semi-skilled labour to rise to level of the capital in a capital abundant country).

Full factor price equalization is never observed.

The Stolper-Samuelson Theorem (S-S)

Given diversification in production, a change in the price of a traded good results in a more than proportional change, in the same direction, in the price of the factor that is used in the production of that good more intensively.

Example 3. (Stolper-Samuelson Theorem)

Consider a country of Example 2

	Price of X	Price of Y	Rental rate of capital	Wage rate
Level	28	10	0.8	4
Percentage change	10%	0%	93.3%	-23.3%
	10%	10%	10%	10%
	0%	10%	-83.3%	33%
	10%	5%	52%	-7%

A 10% increase in price of X gets 93.3% increase in rental rate and 23.3% reduction in wage.

price of good = rental rate × number of units of capital
+ wage rate × number of units of labour

The price of good X: $p_X = a_{KX} \cdot r + a_{LX} \cdot w,$

The price of good Y: $p_Y = a_{KY} \cdot r + a_{LY} \cdot w.$

Assumption: Total amount of X = 100 units;
Total amount of Y = 200 units;

$$a_{KX} = \frac{1000}{100} = 10, \quad a_{LX} = \frac{500}{100} = 5,$$

$$a_{KY} = \frac{500}{200} = 2.5, \quad a_{LY} = \frac{400}{200} = 2$$

$$a_{KX} = \frac{K_X}{X}, \quad a_{LX} = \frac{L_X}{X}, \quad a_{KY} = \frac{K_Y}{Y}, \quad a_{LY} = \frac{L_Y}{Y}.$$

The Stolper-Samuelson theorem explains how international trade may affect the distribution of income among different factors within nations.

- The changes in output prices resulting from trade will lead to (more than proportional) changes in the relative input prices.

- The price of the abundant factor will increase proportionally more than the increase in the price of the good that uses the abundant factor intensively: that results in the increase in the real wages in a labour abundant country.

- The price of the scarce resources will decrease proportionally more than the decline in the price of the good that uses the scarce resource intensively: the rental price of capital in the capital poor country will decrease.

- Increased trade between a skilled labour abundant economy and unskilled labour abundant economy will increase the relative wage of skilled workers in the skilled labour abundant economy.

- Trade benefits the abundant factor of production. Abundant factors have a larger share of the rising real income of nation.

- Scarce factors may gain, lose, or experience no change in real income depending upon whether their falling share of national income is offset by the increase in real income.

Example 4.

Consider a capital abundant country with its national income 1000 units of currency, capital share of national income is 60% (600), labour share is 40% (400). After trade national income rises by 10% (level 1100).

Owners of labour:

- are worse off, when labour experiences a 5% fall (level: 0.35*1100=385),
- experience no change, when labour decreases by 3.63% (400/1100=0.3636; 0.4-0.3636=0.03636) (level: 400),
- are better off, when labour experiences a 2% fall (level: 418).

	Country A	Country B
Abundant factor	Capital	Labour
Comparative advantage (H-O)	Capital-intensive product	Labour-intensive product
Affect of specialization and trade on factor prices (FPE)	Increase in price of capital relative to wage	Increase in wage relative to price of capital
Winners (S-S)	Owners of capital	Labour force

The Rybczynski Theorem - 1955

Holding relative goods prices constant and if both commodities continue to be produced, an increase in the endowment of one factor of production will lead to an increase in the output of the good using that factor intensively and a decrease in the output of the other good.

Suppose that the economy's capital endowment is increased while commodity (and thus factor as well) prices are fixed.

- In order to absorb the increase in capital endowment, the capital-intensive sector must expand.

- When the capital-intensive sector expands, it attracts labour from the labour-intensive sector, leading to a drop in the latter's production.

Suppose that the economy's capital endowment is increased while commodity (and thus factor as well) prices are fixed.

- Because the labour-intensive sector releases not only labour but also capital, the increase in capital in the capital-intensive sector must be more than the increase in capital endowment.

- This implies that percentage increase in capital-intensive output is greater than that in the capital endowment.

Example 5. (Rybczynski Theorem)

Consider a country of Example 2

	Total Capital	Total Labour	Good *X*	Good *Y*
Level	1500	900	100	200
Percentage change	10%	0%	40%	-50%
	10%	10%	10%	10%
	0%	10%	-30%	60%
	10%	5%	25%	-20%

A 10% increase in capital gets 40% increase in production of capita-intensive output (good *X*) and 50% reduction in production of labour-intensive output (good *Y*)

Holding a_{KX}, a_{LX}, a_{KY}, a_{LY} constant, to obtain X and Y one's must solve the following system of linear equations:

$$\begin{cases} K = a_{KX} \cdot X + a_{KY} \cdot Y \\ L = a_{LX} \cdot X + a_{LY} \cdot Y \end{cases} \rightarrow \begin{cases} 1500 = 10 \cdot X + 2.5 \cdot Y \\ 900 = 5 \cdot X + 2 \cdot Y \end{cases} \rightarrow \begin{cases} X = 100 \\ Y = 200 \end{cases}$$

Conclusions

- Interaction between differences in factor abundance across countries and differences in factor intensity across industry is the key to understanding the determinants and effects of international trade.

- A country will export the commodity that uses well-endowed factor more intensively.
- Exports as a group should be more intensive in use of the abundant factor than imports as a group.

Conclusions

- The Stolper-Samuelson theorem, which relates changes in commodity prices to changes in real factor prices, provides a fundamental prediction about the effects of trade on the distribution of real incomes between capital and labour.

- Because free trade causes exports and imports to rise, it follows that relatively abundant factor gains real income in each country and the scarce factor loses real income.

- Both countries gain from trade, but free trade causes a redistribution of real income between capital and labour in comparison with autarky.

Testing the H-O Model

- Does the theory explain international trade patterns?

- How do international trade patterns change over time?

The Leontief Test – 1953

- First test: Leontief used 1947 data for US (since US was capital-abundant, it was expected that US would export capital-intensive goods).

- Since data on factor intensity of imports was not available, Leontief used data on import substitutes (the US-produced versions of the import goods).

- One million dollars' worth of typical exportable and importable bundles in 1947.

- Empirical results showed the opposite of what was expected (US exports were more labour-intensive than US import substitutes) - known as **Leontief paradox**.

Domestic capital and labour requirements per million dollars of US exports and of competitive replacements (of average 1947 composition)

	Capital (USD, in 1947 prices)	Labour (man-years)	K/L
Exports	2,550,780	182.313	13,991
Import replacements	3,091,339	170.004	18,184

- The second Leontief test - 1956.

- In 1947 most of world's economies were still in a highly disrupted state (further test reduced the magnitude of the paradox – the 1951 US trade data, US imports were 6% more capital-intensive).

- Robert Baldwin (1971) used the 1962 US trade data – US imports were 27% more capital-intensive than US exports.

Trade patterns of other countries

- Tatemoto and Ichimura (1959) studied Japan's trade patterns and discovered another paradox. Japan was a labour-abundant country, but exported capital-intensive goods and imported labour-intensive goods. Japan's overall trade pattern was inconsistent with HO.

  For the US-Japan trade, the trade pattern was consistent with HO prediction. Japan-LDC, consistent.

- Bharawaj (1962) – India's exports were labour-intensive, consistent. (Indian exports to the US were capital-intensive).
- Hong (1975) – Korea's trade pattern (1966-72), consistent.
- Bowen, Leamer, Sveinkauskas (1987) – 27 countries (1967), inconsistent with HO

Explaining the paradox

1. Serious mistakes or inaccuracies were made in passing from the theoretical formulation to its empirical testing.

2. One or more of the basic assumptions are not fulfilled in reality.

Explaining the paradox (1)

- Leontief - American workers may be more efficient than foreign workers. The United States – labour abundant country.
- One man-year of American labour =three man-years of foreign labour.

- Human capital – US exports are intensive in human capital.

Explaining the paradox (1)

- Natural resources – US imports are intensive in natural resources – Vanek (1959).
- Leontief may have oversimplified the production functions and failed to recognize the endowments of natural resources.
- With two factors of production, the HO model does not predict much. This is because the notion of abundance and intensity must be redefined.
- Example – oil extractive industry (US – Saudi Arabia)
- US imports intensive in natural resources; exports intensive in capital and labour relative to natural resources.

Explaining the paradox (1)

- In reality trade balances are not in equilibrium and paradoxical empirical results can be due to the non-verification of this condition.
- Cas and Choi (1984) - under the balance-of-trade equilibrium US exports were more capital intensive.

Explaining the paradox (2)

- A capital abundant country need not export the capital-intensive goods if it tastes are strongly biased toward capital-intensive goods.

- The Leontief paradox can be explained if the US had a strong consumption bias toward the capital-intensive goods.

Explaining the paradox (2)

- Factor-intensity reversal – suppose that a good is capital intensive in one country but labour-intensive in another, then the H-O theorem is violated in one country.

  Example: Agriculture is labour-intensive in India but capital intensive in US.

- If the US imports agricultural products, then the Leontief paradox occurs in the US, because a capital abundant country is importing the capital intensive product.
- If the US exports agricultural products, then the Leontief paradox occurs in India, because a labour-abundant country, India, is importing the labour-intensive goods.

Explaining the paradox (2)

- Capital mobility

- Wood (1994), North-South trade in manufactures.
- North abundant in skilled labour – South in unskilled labour.

Explaining the paradox (2)

- **Role of tastes** (the model assumed tastes were identical across countries). Large differences in tastes among countries can introduce a taste bias that can dominated the production bias (consumers in a given country tend to consume more domestically produced goods than we would expect).

- **Classification of inputs** (the original theory used only two inputs: capital and labour). Inputs can be classified in several ways (human capital, raw materials or natural resources, arable farmland, unskilled labour).

Explaining the paradox (2)

- **Technology, productivity and specialization** (the original theory assumed identical technologies across countries - countries would export goods that use their abundant factors intensively).
- However, we clearly observe different technologies across countries. The theory must be amended to take these production process differences into account.

Weaknesses of the H-O theory

- A large fraction of world trade is that among developed countries, rather than that between developed and less developed. (H-O would lead to the conclusion that developed countries are more likely to trade with developing countries (who have very different endowments) rather than with each other.)

- It ignores the existence of intra-industry trade.

- A significant percentage of world trade is carried out by large corporations - the importance of monopolies and oligopolies.

Trade with Economies of Scale

Intra-Industry Trade

Theory of Overlapping Demands (Linder, 1961)

Product Life Cycle Theory (Vernon, 1966)

Gravity Model

Economies of Scale

Key notions: Increasing returns to scale, decreasing average costs

- Returns to scale refers to the way that output changes as we change the scale of production. If we scale all inputs up by some amount *t* and output scales up by more that *t* we have **increasing returns to scale**.

- If technology exhibits increasing returns to scale, then the costs will increase less than linearly with respect to output, so average costs of production will tend to fall.

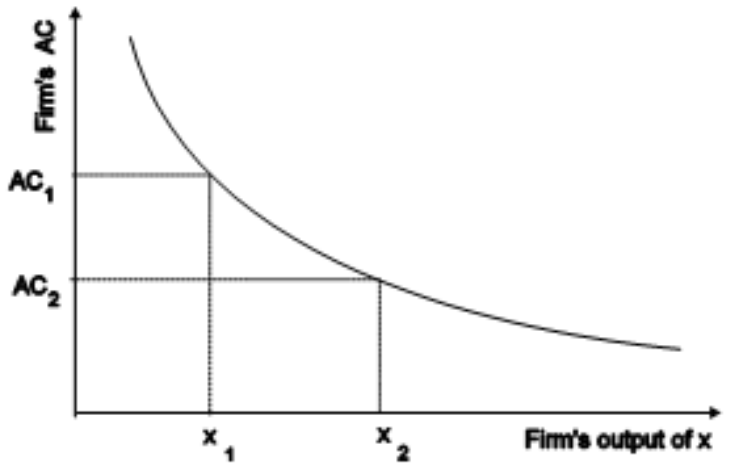
Economies of scale - production exhibits increasing returns to scale.

- **Internal economies of scale** occur when the firm's average costs fall as the firm's output rises (large fixed costs that can be spread over all the firm's output).

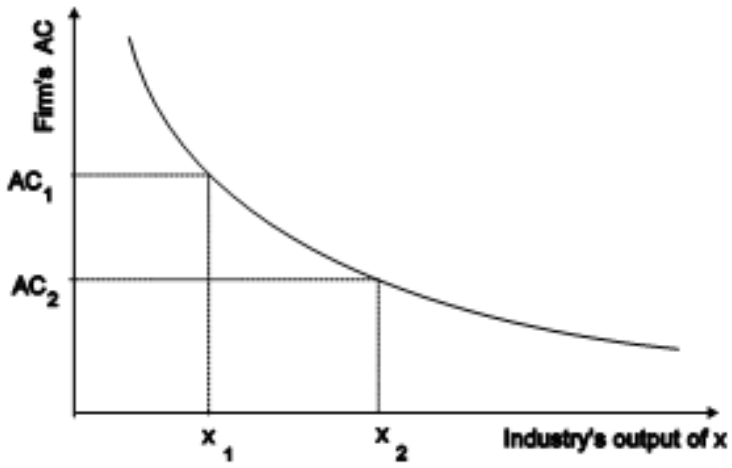
- **External economies of scale** occur when the firm's average costs fall as the industry's output rises.
- For example, when the output of the computer industry rises, computer firm's costs fall because the industry becomes large enough to support a pool of skilled labour.

Graphical illustration

Internal economies of scale



External economies of scale



- Implication of economies of scale - creation additional incentive for production specialization.

- Rather than producing a few units of each good that domestic consumers want to buy, a country can specialize in producing large quantities of a small number of goods - in which the industries achieve economies of scale - and trade for the remaining goods.

- Economies of scale provide a basis for trade even between countries with identical production possibilities and tastes.

- With **internal economies** of scale, trade allows consumers to consume larger varieties of goods at lower prices.
- Trade helps to increase variety by expanding the consuming population for any firm’s product.
- Firms in one country specialize in one set of varieties, and firms in the other country in another set.
- Each firm achieves economies of scale by specializing.

- **External economies** of scale can help to explain the observed phenomenon of industrial agglomeration - the tendency of firms in an industry to cluster geographically
- Examples: Silicon Valley, movie industry in Hollywood or in Bollywood or in Nollywood, financial industry in New York and London.

- Increasing returns to scale - firms that produce more will have cost advantage over smaller producers.
- The firms that produce the first may be able to derive competitors out of business, leaving the industry dominated by a few large international oligopolies.
- Technology and strategic behaviour determine who gains advantage in the international market.

Intra-Industry Trade

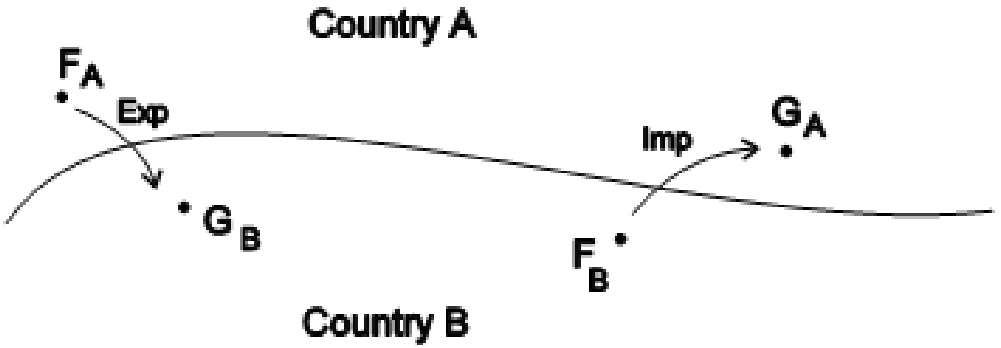
- Defined as trade in which each country both imports and exports products from the same industry.

- Intra-industry trade in **homogenous goods or** in **differentiated goods**.

- **Homogenous** (non-differentiated) goods that are most likely to be involved in intra-industry trade include items that are heavy or for some other reason expensive to transport.
- Transportation cost and geographic location can cause intra-industry trade in homogenous goods.

Intra-industry trade in **homogenous goods.**

Country both exports and imports the product because of the greater proximity of consumers to the foreign than to domestic producer.



Intra-industry trade in **differentiated goods**

Product differentiation is the most obvious explanation for intra-industry trade. Consumers have a variety of tastes, some best served by domestically produced goods and others by imports.

Intra-industry trade in **differentiated goods**

Intra-industry trade

- **in horizontally differentiated products** is associated with a specialization in varieties (*e.g.* cars of a similar class and price range) – enables countries with similar factor endowments to benefit from economies of scale by specialising in "niche" products.

- **in vertically differentiated products** is distinguished by quality and price (*e.g.* Italy exports high-quality clothing and imports lower-quality clothing) – may reflect different factor endowments, particular skills of the workforce or high fixed research and development costs.

- **due to vertical specialisation of production** - trade in similar goods at different stages of production – may be driven by comparative advantage, for example to use cheap unskilled labour for assembly purposes or specialised personnel for research and development.

The Measurement of Intra-Industry Trade

The Grubel-Lloyd index (1975)

For any particular product class i, an index of the extent of intra-industry trade in the product class i between countries A and B is given by the following ratio

$$IIT_{i,AB} = 1 - \frac{|E_i - I_i|}{E_i + I_i}, \qquad IIT_{i,AB} \in \langle 0,1 \rangle$$

where E_i is a volume of export of i-th branch;

I_i is a volume of import of i-th branch,

The Grubel-Lloyd index

The index takes the minimum value of zero when there are no products in the same class that are both imported and exported, and the maximum value of 100 when all trade is intra-industry.

Example 1. (IIT – Grubel-Lloyd index)

Export	Import	Intra-industry Trade Index
100	0	0
0	100	0
100	100	1
100	50	0.67
300	150	0.67
450	50	0.2

$$IIT_{i,AB} = 1 - \frac{|E_i - I_i|}{E_i + I_i}$$

The Balassa index in i-th industry

$$B_{i,AB} = \frac{|E_i - I_i|}{E_i + I_i}$$

The index belongs to closed interval $B_{i,AB} \in \langle 0,1 \rangle$ where lower bound implies perfect intra-industry trade, while the highest bound implies perfect inter-industry trade.

- The extent of intra-industry trade is typically much higher across categories of **manufactured goods** than it is across trade in non-manufactured goods, and highest for the more sophisticated manufactured products such as chemicals, machinery and transport equipment, electrical equipment and electronics.

- Intra-industry trade indexes tend to be higher for industrialized countries than for developing ones.

- Export and import similar products reflect a complexity of international division of labour.

- Intra-industry trade comprises a significant share of world trade.

Theory of Overlapping Demands

Linder, Stefan B. (1961), *Essay on Trade and Transformation*, New York: John Wiley&Sons

- The H-O theory is a theory of trade based upon supply: trade takes place because of differences in the supply factors such as capital, labour. It centres on expected trade patterns when countries have different capacities for productions, but similar tastes.

- Linder noticed that some trade (especially in consumer goods) has little to do with supply and is based upon **demand**. He suggested that similarities in demand between two countries can form a basis for trade, especially for manufactured goods.

Theory of Overlapping Demands

- The Linder hypothesis states that demand plays more important role than comparative advantage as a determinant of trade.
- Countries which share similar demands will be more likely to trade.
- Linder's theory can be used to explain trade between countries with similar per capita income.

Theory of overlapping demands

- Demand oriented, for manufactured goods only.
- Countries with different per capita income demand for different goods.
- The quality of the good that consumers in specific country demand depends primarily on their income (consumer with higher incomes tend to demand goods of higher quality).
- Firms typically produce goods for which domestic demand exists.
- Similarities in overall demand plus variations in individual tastes.

Theory of overlapping demands

- Let consider three countries I, II, III (I is the poorest and III the richest) and 7 goods (ranked in terms of degree of sophistication, A is the lowest)

Country	A	B	C	D	E	F	G
I	*	*	*	*			
II			*	*	*	*	
III					*	*	*

* - a good for which there is local demand and thus the good that will be produced under autarky.

- Country I demands for goods A-D, country II for C-F, and country III for E-G.
- Goods C and D can be traded between countries I and II, and goods E and F between countries II and III.

- Linder's theory suggests that rich countries, with similar income levels and factor endowments, might actually trade similar products with each other based upon similar types of demands and differences in tastes and preferences.

- For example: Germany, Sweden and Japan all have high income levels and consumers who can afford to purchase luxury cars.

- Tests of Linder theory have shown it to be a good predictor of trade – but it can't predict patterns, nor volumes.

Product Life Cycle Theory

Vernon, Raymond (1966), *International Investment and International Trade in the Product Cycle*, Quarterly Journal of Economics, 80(2), pp 190-207.

- **Product life cycle theory** tries to explain the change in patterns of trade of a product over time as a product is developed.

- Timing of innovation; the effects of scale economies.

Product Life Cycle Theory - assumptions

- Technological innovation and new-product development tend to occur in major industrialized economies, because of

- relatively high level of R&D expenditures;
- highly educated and skilled workforce;
- high demand for labour-saving;
- high demand for luxurious products;
- more developed consumer's markets (actual production needs to be located close to consumers so they can provide feedback on its refinement).

Product Life Cycle Theory - assumptions

- Each product moves through its life cycle (theory divides the life of a product into three stages).

New Product Stage

Maturing Product Stage

Standarized Product Stage

Stages of Product Development - New Product Stage

- A new product is developed in the advanced country.
- The domestic firm owns the technology - production occurs in the firm's home country.
- The firm perfects the product - production accelerates, first for the domestic market and then for export.
- The may be demand for this product in other developed countries.
- Only a few producers - oligopolists.
- Production of the product in other developed countries is low (nearly zero) at an early stage.

Stages of Product Development - Maturing Product Stage

- Some standarization of the product.
- Economies of scale (perhaps mass production).
- Demand in other developed countries grows.
- The innovating firm may find it profitable to license its technology to firms abroad.
- Technology transfer partly through foreign direct investment.
- Production in other developed countries grows.
- Demand in less developed countries rises.
- Export from other developed countries to the inventor country possible.

Stages of Product Development - Standarized Product Stage

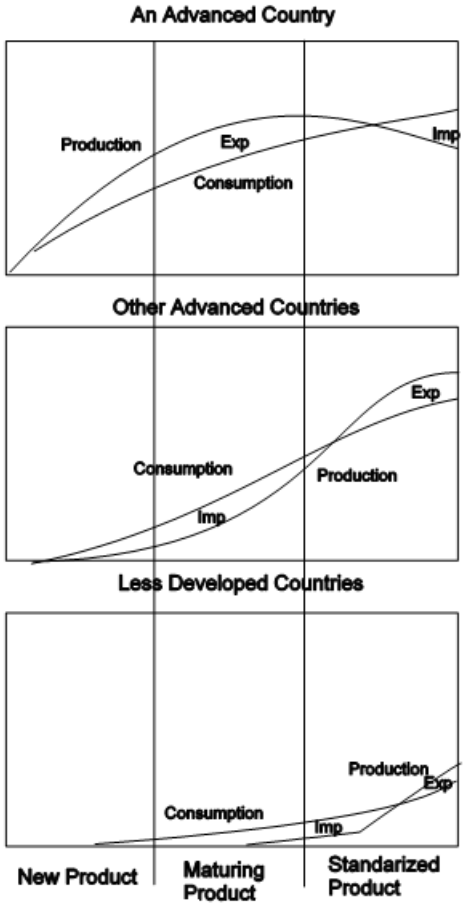
- Product highly standarized.
- Many producers in the world.
- Technology widespread, mass production possible.
- Production may relocate to other countries with lower costs of production (labour cost important in deciding the competitiveness of a product).
- Large production in less developed countries.
- Imports rather than domestic production begin to serve the domestic market of the innovating country (domestic consumption of the good may continue, imports satisfy that consumption).
- The technology diffused completely. Finally, the product completes its cycle.

- Primary implication - as the product moves through its life cycle the geographical location of production will change (possible explanation of shifts in international trade)

- Multinational corporations:

- produce high tech products at home when products are human capital intensive;
- export products to the other wealthy (human capital abundant) countries;
- import products when products have become standarized, which means that products intensively use semi-skilled labour rather than skilled labour.

Graphical illustration



There are two basic explanation of international trade

- **Comparative advantage** – countries trade to take advantage of their differences
- **Increasing returns** – countries trade to take advantage of advantages of specializations, which allows large-scale production

- Before World War I – trade fitted the comparative paradigm very well. For example GB – exports of manufactured good, imports of raw materials. Trade with primary-product exporters that had much higher land-labour ratios.
- After World War II – trade between similar countries (as a result of liberalization agreements) and in similar goods (intra-industry trade). Specialization due to increasing returns
- Trade liberalization in developing countries, trade between very different countries. External economies of scale

- **Qiaotou** – Capital of Buttons and Zips, 60 per cent of the world's buttons production, 80 per cent of the world's zippers (15 billion buttons, 200 million metres of zippers a year)

- **Wenzhou** – the World's Lighters Kingdom – 90% of the world's cigarette lighters

The Gravity Model

- **Tinbergen, Jan** (1962), *Shaping the World Economy: Suggestions for an International Economic Policy*, New York: The Twentieth Century Fund.

- **Anderson, James E.** (1979), *A Theoretical Foundation for the Gravity Equation*, American Economic Review, 69(1), pp 106-116.

- The gravity equation is a popular formulation for statistical analyses of bilateral flows between different geographical entities.

- Law of Universal Gravitation, Newton, 1687: The attractive force between two objects *i* and *j* is given by

$$F_{ij} = G\frac{M_i M_j}{D_{ij}^2},$$

where: F_{ij} is the attractive force; M_i and M_j are the masses; D_{ij}-is the distance between the two objects; G is a gravitational constant.

- In the 1860s, H. Carey first applied Newtonian physics to the study of human behaviour, and so-called „gravity equation” has since been widely used in the social sciences.

- The gravity model of international trade was developed by Tinbergen (formally derived by Anderson).

- The general gravity law may be expressed:

$$F_{ij} = G\frac{M_i^{\alpha} M_j^{\beta}}{D_{ij}^{\theta}}$$

where: F_{ij} is the flow from origin i to destination j; M_i and M_j are usually the gross domestic product (GDP) or gross national income (GNI) in countries i and j; D_{ij} is the distance between the locations.

- The amount of trade between countries is assumed to be increasing in their sizes, as measured by their national incomes, and decreasing in the distance between their economic centres.

Distance proxies for the

- transport costs (for perishable goods the probability of surviving intact is a decreasing function of time in transit);
- synchronization costs (when factories combine multiple inputs in the production process, they need inputs to arrive in time or bottlenecks emerge);

Distance proxies for the

- communication costs (possibilities of personal contacts between managers, customers);
- transaction costs (distance may be correlated with the costs of searching for trading opportunities and the establishment of trust between potential trading partners);
- cultural distance (cultural differences can impede trade in many ways such as inhibiting communication, generating misunderstandings, clashes in negotiation styles).

The gravity model of trade has been used widely as a baseline model for estimating the impact of a variety of policy issues, including regional trading groups, currency unions, political blocs, patent rights, and various trade distortions.