Chapter 4

Factor Endowment, Comparative Advantage and Income Distribution

(Chapter 5 of textbook)

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Learning goals

- Explain how differences in resources generate a specific pattern of trade
- Discuss why trade will generate both winners and losers
- Understand the meaning of gains from trade when there are losers.
- Discuss the reasons why trade is a politically contentious issue.
- Explain the arguments in favor of free trade despite the existence of losers.

Preview

A model of two factor economy

Effects of International Trade between two –Factor Economies

Empirical evidence on the Heckscher-Ohlin Model

A model of two factor economy

- What is the shape of PPF?
- What is the production level?
- How much is factor level?
- What is the relationship between goods price, factor price and factor level?

Assumptions

1. Only two countries are modeled: Home (H) and Foreign (F)
2. Only two goods are important for production and consumption: cloth and food.
3. Labor (L) and Capital (K) are resources important for production
4. Food: capital intensive; Cloth: labor intensive
5. The amount of labor and capital (factor endowment) varies across countries, and this variation influences productivity.
6. The supply of labor and capital in each country is constant.
7. Competition allows factors of production to be paid a "competitive" wage, a function of their productivities and the price of the good that it produces, and allows factors to be used in the industry that pays the highest wage/rate.

Assumptions (cont.)

8. Technology is identical
9. Tastes and preferences are the same
10. Factors are perfectly mobile within a country but immobile between countries
11. No transportation cost and no barrier to trade

- In this model, the only difference between the countries is the availability of the factors of production

Prices and Production

- Two alternative choices:
  - there is only one way to produce each good **(production without factor substitution)**
  - there is a possibility of substituting capital for labor and vice versa in production (**production with factor substitution)** => more realistic assumption)

Prices and Production (cont.)

PPF without factor substitution

- More than one factor of production => PPF is no longer a straight line.
- Let's expand the previous chapter's model to include two factors of production, labor (L) and capital (K).
  - L = total amount of labor available for production
  - K = total amount of capital available for production
  - a_{LC} = hours of labor used to produce one m^2 of cloth
  - a_{KC} = amount of capital used to produce one m^2 of cloth
  - a_{LF} = hours of labor used to produce one calorie of food
  - a_{KF} = amount of capital used to produce one calorie of food

Prices and Production (cont.)

PPF without factor substitution

- Production possibilities are influenced by *both* capital and labor (requirements):

$$a_{KF}Q_F + a_{KC}Q_C \leq K$$

a_{KF}: Capital required for each unit of food production

Q_F: Total units of food production

a_{KC}: Capital required for each unit of cloth production

Q_C: Total units of cloth production

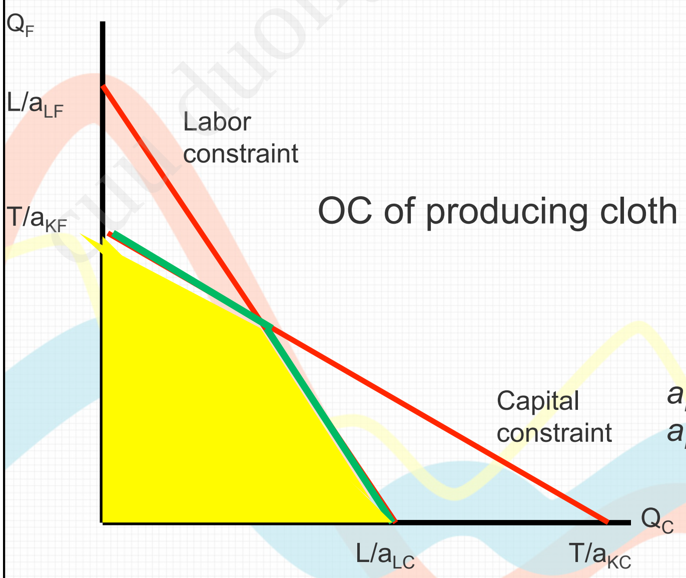
K: Total amount of capital resources

$$a_{LF}Q_F + a_{LC}Q_C \leq L$$

a_{LF}: Labor required for each unit of food production

a_{LC}: Labor required for each unit of cloth production

L: Total amount of labor resources



OC of producing cloth is increasing

$$a_{KF}Q_F + a_{KC}Q_C \leq K$$
$$a_{LF}Q_F + a_{LC}Q_C \leq L$$

PPF without factor substitution (cont.)

- E.g
  - $a_{KC} = 2$; $a_{LC} = 2$; $a_{KF} = 3$; $a_{LF} = 1$
  - K: 3000 and L = 2000
  - Construct and sketch PPF

Prices and Production (cont.)

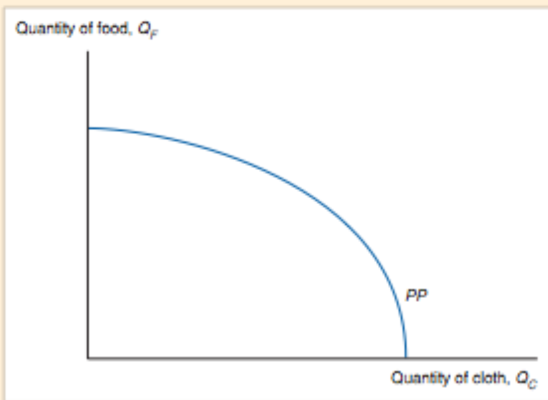
PPF with factor substitution

- PPF becomes curved => PPF has a bowed shape
- Basic insight about how the increasing opportunity costs remains valid.

Figure 5-2

The Production Possibility Frontier with Factor Substitution

If capital can be substituted for labor and vice versa, the production possibility frontier no longer has a kink. But it remains true that the opportunity cost of cloth in terms of food rises as the economy's production mix shifts toward cloth and away from food.



Prices and Production (cont.)

Production point

- PPF: what can produce
- To determine what the production point, must determine the prices of goods => determine through isovalule line.
- An **isovalue** line as a line representing a constant value of production.
  - $V = P_C Q_C + P_F Q_F$
  - $Q_F = V/P_F - (P_C/P_F)Q_C$
  - The slope of an isovalue line is $-(P_C/P_F)$
- In general, the economy should produce at the point that maximizes the value of production

Prices and Production (cont.)

Production point

+ On PPF

+ Maximize value of production

+ At Q

Slope of PPF = Slope of Islovalue line

Opportunity cost = Relative price

OC = (P_C/P_F)

=> Same as One factor model (the Ricardian model)

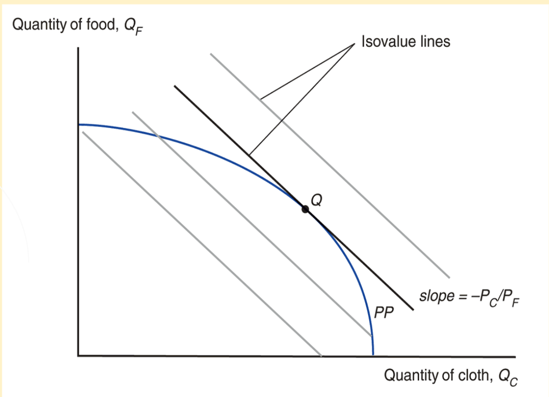


Figure 4-3

Prices and Production

The economy produces at the point that maximizes the value of production given the prices it faces; this is the point that is on the highest possible isovalue line. At the point, the opportunity cost of cloth in terms of food is equal to the relative price of cloth, P_C/P_F.

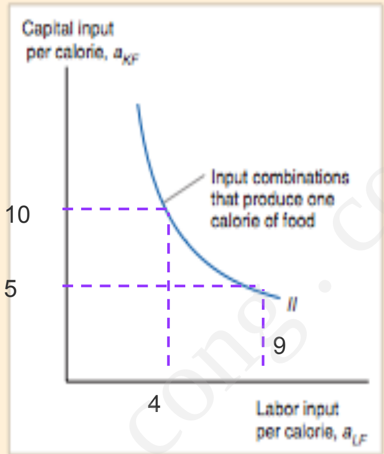
Choosing the mix of inputs

- When we allow the possibility of substituting capital for labor and vice versa => no fixed input requirements as in Ricardian.

Figure 5-4

Input Possibilities in Food Production

A farmer can produce a calorie of food with less capital if he or she uses more labor, and vice versa.



Choosing the mix of inputs (cont.)

Factor Prices and Factor Levels

- Cost of labor = wage rate: *w*
- Cost of capital = capital rents: *r*
- w/r: relative price/cost of labor

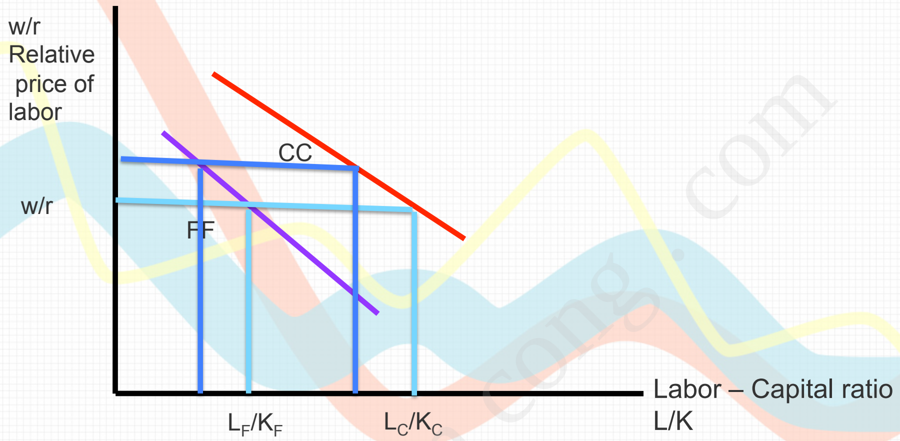
$\left.\begin{array}{l} \text{Cost of capital} \\ \text{w/r} \end{array}\right\}$ Factor price

- The choice of input mix depends on the relative cost of capital and labor.

Choosing the mix of inputs (cont.)

Factor Prices and Factor Levels

- As w/r increases, use more capital and less labor in the production of food and cloth.



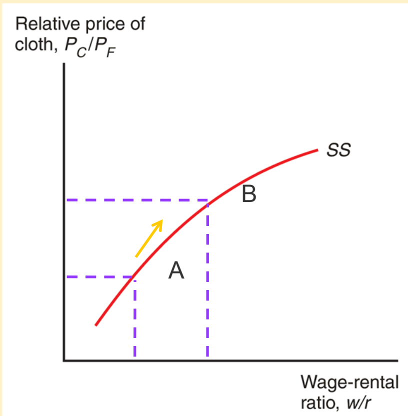
Factor Prices and Goods Prices

- w/r increases
- Cloth is labor intensive; Food is capital intensive
- P_C/P_F increases
- Under competition, changes in *w/r* are therefore *directly related* to changes in P_C/P_W.

Figure 4-6

Factor Prices and Goods Prices

Because cloth production is labor-intensive while food production is land-intensive, there is a one-to-one relationship between the factor price ratio *w/r* and the relative price of cloth P_C/P_F; the higher the relative cost of labor, the higher must be the relative price of the labor-intensive good. The relationship is illustrated by the curve *SS*.



Factor Prices, Goods Prices and Factor Levels

We have a relationship among factor prices and good prices and the levels of factors used in production:

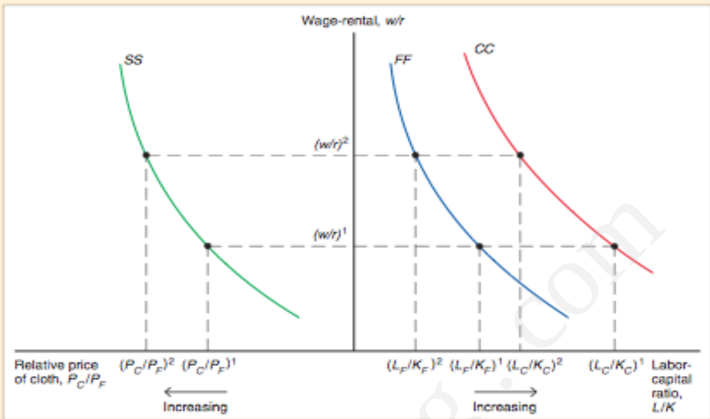


Figure 5-7

From Goods Prices to Input Choices

Given the relative price of cloth $(P_C/P_F)^1$, the ratio of the wage rate to the capital rental rate must equal $(w/r)^1$. This wage-rental ratio then implies that the ratios of labor to capital employed in the production of cloth and food must be $(L_C/K_C)^1$ and $(L_F/K_F)^1$. If the relative price of cloth rises to $(P_C/P_F)^2$, the wage-rental ratio must rise to $(w/r)^2$. This will cause the labor-capital ratio used in the production of both goods to drop.

Factor Prices, Goods Prices and Factor Levels (cont.)

- Stolper Samuelson theorem:
  - If the relative **price** of a good increases, then the real wage or rate of return of the factor used intensively in the production of that good increases, while the real wage or rate of return of the other factor decreases.
- **When the relative prices of goods changes => affect the distribution of income.** owners of one factor of production gain while owners of the other are made worse off.
- If the relative price of cloth (P_C/P_F) increases

⇒ the wage rate increases, while the capital rent rate decreases.

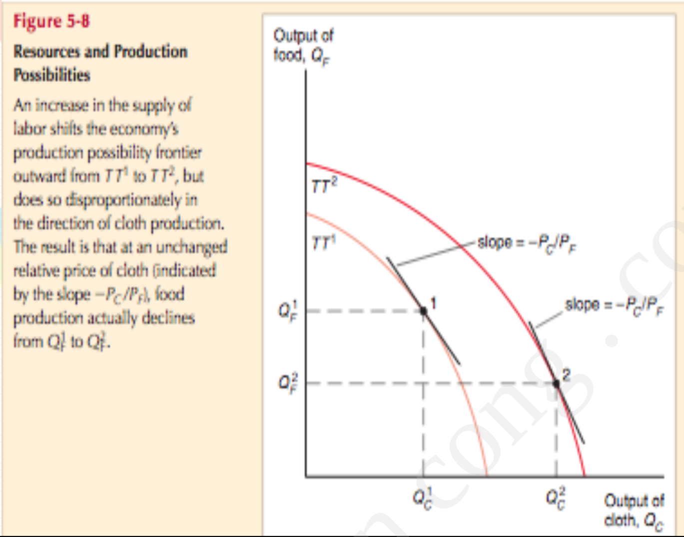
⇒ Raise income of workers relative to that of capital owners.

⇒ raise the ratio of land to labor, *T/L*

⇒ ***Implications for enterprises: prices change => change the costs and the use of inputs***

Resources and output

Assume: an increase in labor supply; Relative price (P_C/P_F) remains constant



Resources and output (cont.)

- If we hold relative price constant, an increase in supply of labor will result in
  – An increase in output of cloth (labor intensive)
  – A fall in output of cloth (capital intensive)
- If we hold relative price constant, an increase in supply of capital will result in
  – An increase in output of food (capital intensive)
  – A fall in output of cloth (labor intensive)

  => Implications for enterprises: changes in factor endowment => change output => change profit

Preview

A model of two factor economy

Effects of International Trade between two –Factor Economies

Empirical evidence on the Heckscher-Ohlin Model

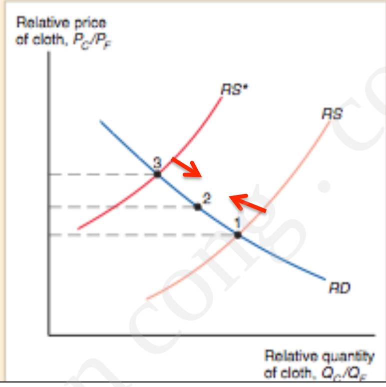
Assumptions

- Assume:
  - Home is **abundant** in labor
  - Foreign is **abundant** in capital:
  - $L/K > L^*/K^*$
  - Have the same technology and same consumer tastes.
  - Cloth (labor intensive) and Food (capital intensive)
- Home is labor abundant and Cloth is a labor intensive good
  - Home will have a higher relative supply of cloth than Foreign at any given relative price of cloth

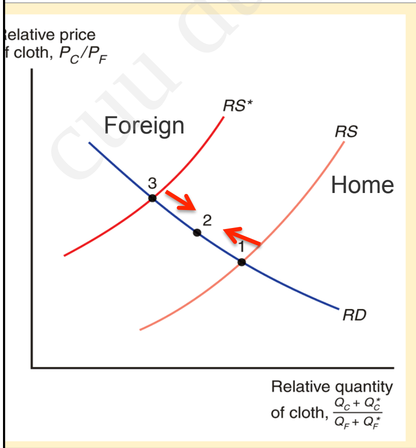
Relative prices and the pattern of trade

- In the absence of trade, P_C/P_F would be lower in Home than in Foreign
- Like the Ricardian model, the Heckscher-Ohlin model predicts a convergence of relative prices with trade.
- A new world relative price lies between the pre-trade prices.

Figure 5-9
Trade Leads to a Convergence of Relative Prices
In the absence of trade, Home's equilibrium would be at point 1, where domestic relative supply *RS* intersects the relative demand curve *RD*. Similarly, Foreign's equilibrium would be at point 3. Trade leads to a world relative price that lies between the pre-trade prices, that is, at point 2.



Trade in the Heckscher-Ohlin Model



- With trade, P_C/P_F will rise in Home and fall in Foreign

⇒ Home: becomes an exporter of cloth and an importer of food.

⇒ Foreign: become an importer of cloth an exporter of food.

Heckscher –Ohlin (H-O) theorem

- The country that is abundant in a factor exports the good whose production is intensive in that factor
  - A country is abundant in labor => exports labor-intensive products
  - A country is abundant in capital => exports capital-intensive products
  - A country is abundant in land => exports land-intensive products

Trade and income distribution

- Factor Price Equalization (H-O-S theorem): Unlike the Ricardian model, the Heckscher-Ohlin model predicts that factor prices will be equalized among countries that trade.
  - Relative prices are equalized
  - Direct relationship between relative prices and factor prices
- In autarky: Home - labor abundant, Foreign - capital abundant => $w/r < w^*/r^*$
- With trade:
  - Home: exports cloth; Foreign exports food.
  - Relative price of cloth in Home increases => w/r increases
  - Relative price of cloth in Foreign decreases => w^*/r^* decreases.
  - Until $w/r = w^*/r^*$
- *Income distribution effects of international trade: Owners of a country's abundant factors gain from trade, but owners of a country's scarce factors lose.*

Trade and income distribution (cont.)

- Because of effects of trade on income distribution, trade is politically contentious issue
- Suppose a government wants to maximize the welfare of its population.
- If everyone is exactly the same in tastes and income: free trade would clearly serve the government objectives.
- A nation: different groups
- When people are not exactly alike, the government must somewhat weigh one person's gain against another person's loss.

Trade and income distribution (cont.)

- There are many reasons why one group might matter more than another
  - A compelling reason: special treatment for a particular group (US: workers in garment and shoes industry).
  - Trade would be allowed only if it doesn't hurt lower-income people
  - Therefore, a country must conduct trade protectionism

  => However, few international economists would agree. Economists are generally in favor of free trade

Trade and income distribution (cont.)

- 3 main reasons why economists do not generally stress the income distribution effects of trade:
- First reason: Income distribution effects are not specific to international trade
- Second reason: It would always be better to compensate the losers from trade (or any economic change) than prohibit trade.
  - The economy as a whole does benefit from trade.
  - Use safety net (unemployment benefits, retraining…)
- Third reason: There is a political bias in trade politics: potential losers from free trade are better politically organized than the winners from free trade.

Preview

A model of two factor economy

Effects of International Trade between two –Factor Economies

Empirical evidence on the Heckscher-Ohlin Model

Empirical evidences – HOS model

- The theory of factor price equalization is simple and appealing
- In the real world: factor prices are not really equal across countries.E.g:

TABLE 4-1 Comparative International Wage Rates (United States = 100)

Country	Hourly Compensation of Production Workers, 2000
United States	100
Germany	121
Japan	111
Spain	55
South Korea	41
Portugal	24
Mexico	12
Sri Lanka*	2

Empirical evidences – HOS (cont.)

TABLE 5-1 Comparative International Wage Rates (United States = 100)

Country	Hourly Compensation of Production Workers, 2005
United States	100
Germany	140
Japan	92
Spain	75
South Korea	57
Portugal	31
Mexico	11
China*	3

*2004

Source: Bureau of Labor Statistics, *Foreign Labor Statistics Home Page.*

Empirical evidences – HOS (cont.)

- Assumptions
  - Both countries produce both goods
  - Technologies are the same
  - Trade actually equalize the prices of goods in the two countries.
- Countries may produce different goods.
- Different technologies could affect the productivities of factors and therefore the wages/rates paid to these factors.
- Trade barriers and transportation costs may prevent goods prices and factor prices from equalizing.

Empirical Evidence of the Heckscher-Ohlin Model

- Wassily Leontief (winner of Noble prize in 1973) study publised in 1953.
  - Tests on US data
  - Leontief found that US exports were less capital-intensive than US imports, even though the US is the most capital-abundant country in the world: **Leontief paradox**.

TABLE 4-2 Factor Content of U.S. Exports and Imports for 1962

	Imports	Exports
Capital per million dollars	$2,132,000	$1,876,000
Labor (person-years) per million dollars	119	131
Capital-labor ratio (dollars per worker)	$17,916	$14,321
Average years of education per worker	9.9	10.1
Proportion of engineers and scientists in work force	0.0189	0.0255

Source: Robert Baldwin, "Determinants of the Commodity Structure of U.S. Trade," *American Economic Review* 61 (March 1971), pp. 126–145.

Empirical Evidence of the Heckscher-Ohlin Model (cont.)

- Why do observe the Leontief paradox?
  - The US has a special advantage in producing new products made with innovative technology.
  - Such products may well be less capital intensive than imported products.
  - Thus the US may be exporting goods that heavily use skilled labor and innovative entrepreneurship, while importing the heavy manufactured products such as automobiles that use large amount of capital.

Empirical Evidence of the Heckscher-Ohlin Model (cont.)

- Tests on global data
  - Bowen, Leamer, and Sveikauskas tested the Heckscher-Ohlin model on data from 27 countries and 12 factors of produciton
  - They confirmed the Leontief paradox on an international level: trade often does not run in the direction that the Heckscher-Ohlin theory predicts.

TABLE 5-3 Testing the Heckscher-Ohlin Model

Factor of Production	Predictive Success*
Capital	0.52
Labor	0.67
Professional workers	0.78
Managerial workers	0.22
Clerical workers	0.59
Sales workers	0.67
Service workers	0.67
Agricultural workers	0.63
Production workers	0.70
Arable land	0.70
Pasture land	0.52
Forest	0.70

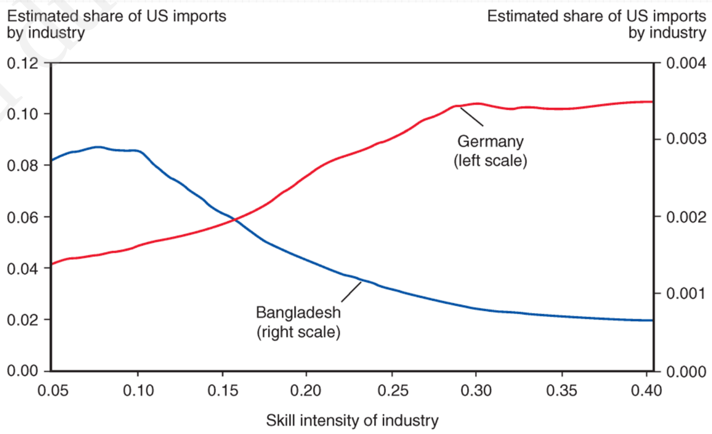
*Fraction of countries for which net exports of factor runs in predicted direction.

Source: Harry P. Bowen, Edward E. Leamer, and Leo Sveikauskas, "Multicountry, Multifactor Tests of the Factor Abundance Theory," *American Economic Review* 77 (December 1987), pp. 791–809.

Empirical Evidence of the Heckscher-Ohlin Model (cont.)

- Tests on manufacturing data between developed and developing countries
  – This data do fit the theory quite well.

Fig. 4-15: Skill Intensity and the Pattern of U.S. Imports from Two Countries

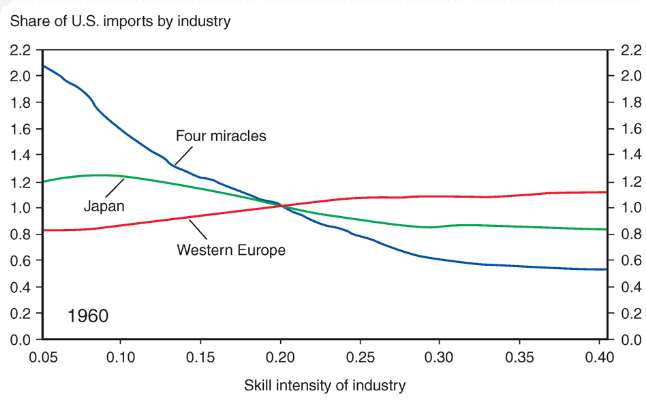


Source: John Romalis, “Factor Proportions and the Structure of Commodity Trade,” *American Economic Review*, March 2004.

Empirical Evidence of the Heckscher-Ohlin Model (cont.)

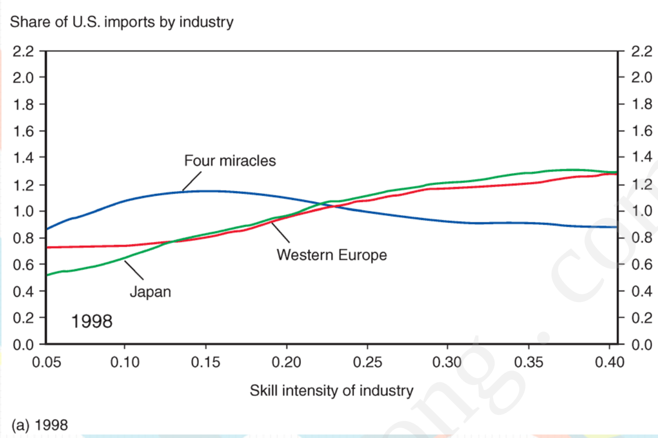
- Changes over time also follow the predictions of the H-O model.

Fig. 4-16.a - Changing Patterns of Comparative Advantage



(a) 1960

Fig. 4-16.b - Changing Patterns of Comparative Advantage (continued)



Implications of the empirical evidences

- The empirical evidence broadly supports the Ricardian model's predictions.
- By contrast, the H-O model has long occupied a central place in the trade theory.
- The mixed results of tests of the H-O model place international economists in a difficult position.
- While the H-O model has been less successful at explaining the actual pattern of trade that one might hope, it remains vital for understanding the effects of trade, especially its effects on the distribution of incomes.

Key points in H-O model (read more at page 104 in textbook)

1. Comparative rather than absolute advantage that matters and determine trade.
2. Differences in factor endowment (abundance of resources, availability of resources) play an important role in international trade and gives rise to trade.
3. A two factor economy

- Assumptions of the 2x2x2 model
- Shape of PPF in two-factor model and increasing opportunity cost principles => production point (the opportunity cost of producing a good equals the relative price of that good).
- Relationship between factor prices, good prices and factor level and implications for enterprises
  - Changes in relative prices results to changes in the distribution of income (Stolper Samuelson theorem
  - Changes in factor => change in output

Key points in H-O model (cont.)

4. Trade pattern in H-O model: H-O theorem

 - The country that is abundant in a factor exports the goods whose production is intensive in that factor

5. Effects of trade on the distribution of income:

 - H-O-S theorem (Factor price equalization theorem)

 - Owners of abundant factors gain, but owners of scarce factors lose with trade.

- Trade affect income distribution => limit or promote trade?

6. Empirical support of the Heckscher-Ohlin model is weak except for cases involving trade between high income countries and low/middle income countries.

END OF CHAPTER 4