Modern Theories of International Trade:

Heckscher-Ohlin theory

Background

- The primary work behind the Heckscher-Ohlin model was a 1919 Swedish paper written by Eli Heckscher at the Stockholm School of Economics.
- His student, Bertil Ohlin, added to it in 1933. Economist Paul Samuelson expanded the original model through articles written in 1949 and 1953. Some refer to it as the Heckscher-Ohlin-Samuelson model for this reason.
- For his work on the theory, Ohlin was awarded the Nobel Prize for Economics (the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel) in 1977.
- The comparative advantage was based on the difference in the *productivity of labor* (the only factor of production they explicitly considered) among nations, but they provided no explanation for such a difference in productivity, except for possible differences in climate.
- The Heckscher–Ohlin theory goes much beyond the earlier trade model to examine the basis for comparative advantage and the effect that trade has on factor earnings in the two nations

Theory

- The **Heckscher–Ohlin theorem** as follows: *A nation will export the commodity whose production requires the intensive use of the nation's relatively abundant and cheap factor and import the commodity whose production requires the intensive use of the nation's relatively scarce and expensive factor*.
- In short, the relatively labor-rich nation exports the relatively labor-intensive commodity and imports the relatively capital-intensive commodity.
- In terms of our previous discussion, this means that Nation 1 exports commodity X because commodity X is the *L*-intensive commodity and *L* is the relatively abundant and cheap factor in Nation 1. Conversely, Nation 2 exports commodity Y because commodity Y is the *K*-intensive commodity and *K* is the relatively abundant and cheap factor in Nation 2 (i.e., $r\ w$ is lower in Nation 2 than in Nation 1).

Assumptions

1. There are two nations (Nation 1 and Nation 2), two commodities (commodity X and commodity Y), and two factors of production (labor and capital).
2. Both nations use the same technology in production.
3. Commodity X is labour intensive, and commodity Y is capital intensive in both nations.
4. Both commodities are produced under constant returns to scale in both nations.
5. There is incomplete specialization in production in both nations.
6. Tastes are equal in both nations.
7. There is perfect competition in both commodities and factor markets in both nations.
8. There is perfect factor mobility within each nation but no international factor mobility.
9. There are no transportation costs, tariffs, or other obstructions to the free flow of international trade.
10. All resources are fully employed in both nations.
11. International trade between the two nations is balanced.

- Assumption 2 (that both nations use the *same technology*) means that both nations have access to and use the same general production techniques.
- Thus, if factor prices were the same in both nations, producers in both nations would use exactly the same amount of labor and capital in the production of each commodity.
- Since factor prices usually differ, producers in each nation will use more of the relatively cheaper factor in the nation to minimize their costs of production.

- Assumption 3 (that commodity X is **labor intensive** and commodity Y is **capital intensive**) means that commodity X requires relatively more labor to produce than commodity Y in both nations.
- In a more technical and precise way, this means that the **labor–capital ratio** (*L/K*) is higher for commodity X than for commodity Y in both nations at the same relative factor prices.
- This is equivalent to saying that the **capital–labor ratio** (*K/L*)is *lower for X than for Y*.

- Assumption 4 (**constant returns to scale** in the production of both commodities in both nations) means that increasing the amount of labor and capital used in the production of any commodity will increase output of that commodity in the same proportion.
- Assumption 5 (incomplete specialization in production in both nations) means that even with free trade both nations continue to produce both commodities. This implies that neither of the two nations is "very small."
- Assumption 6 (equal tastes in both nations) means that demand preferences, as reflected in the shape and location of indifference curves, are identical in both nations. Thus, when relative commodity prices are equal in the two nations (as, for example, with free trade), both nations will consume X and Y in the same proportion.

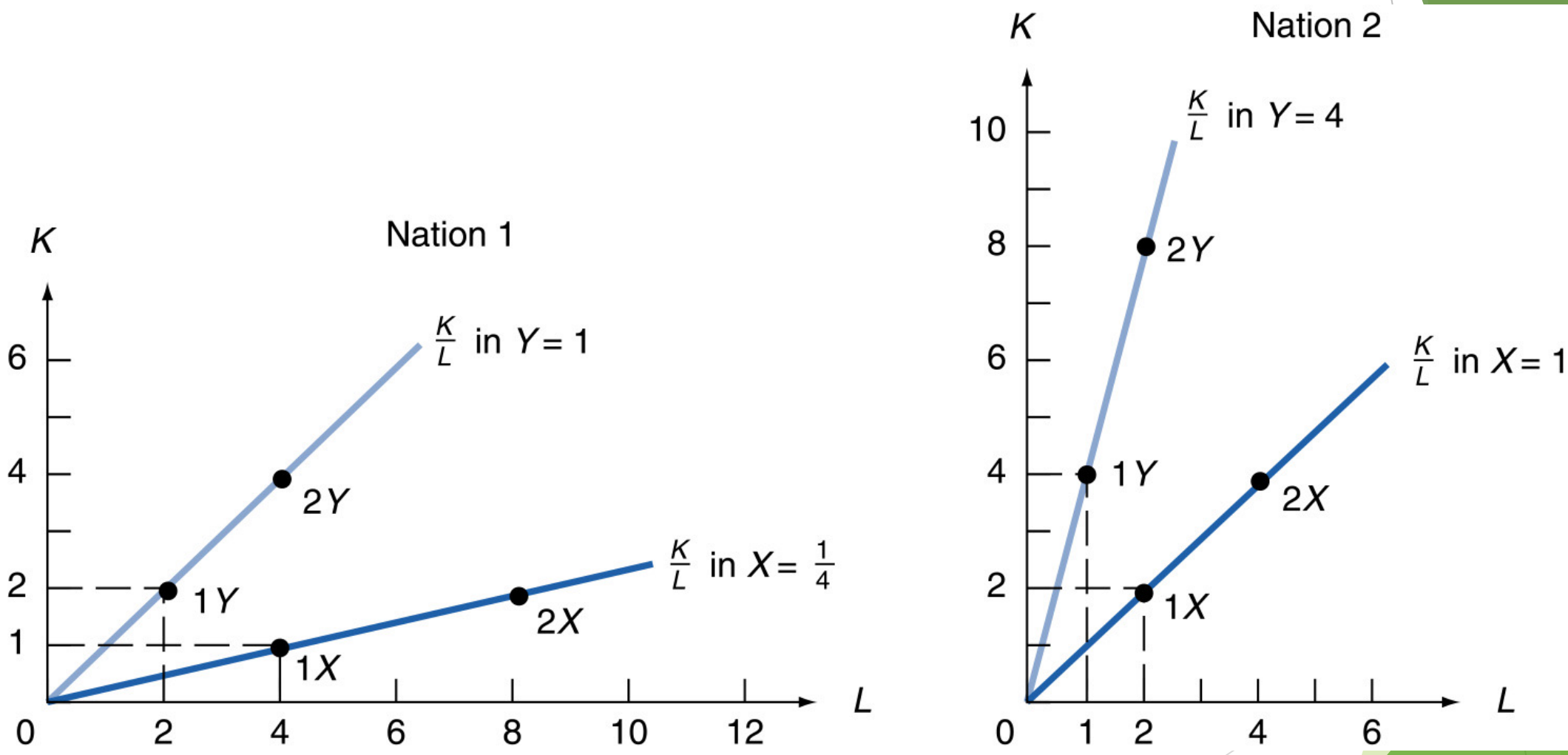
- Assumption 7 (**perfect competition** in both commodities and factor markets) means that producers, consumers, and traders of commodity X and commodity Y in both nations are each too small to affect the price of these commodities. The same is true for each user and supplier of labor time and capital.
- Perfect competition also means that, in the long run, commodity prices equal their costs of production, leaving no (economic) profit after all costs (including implicit costs) are taken into account.
- Finally, perfect competition means that all producers, consumers, and owners of factors of production have perfect knowledge of commodity prices and factor earnings in all parts of the nation and in all industries.
- Assumption 8 (perfect **internal factor mobility** but no international factor mobility) means that labor and capital are free to move, and indeed do move quickly, from areas and industries of lower earnings to areas and industries of higher earnings until earnings for the same type of labor and capital are the same in all areas, uses, and industries within the nation.
- On the other hand, there is zero **international factor mobility** (i.e., no mobility of factors among nations), so the international differences in factor earnings would persist indefinitely in the absence of international trade.

Factor Intensity, Factor Abundance, and the Shape of the Production Frontier (PF)

A. Factor Intensity

- In a world of 2 commodities and 2 factors, Y is capital intensive if its (K/L) is greater than (K/L) of X.
- If the production of Y requires 2K and 2L, then K/L=1.
- If the production of X requires 1K and 4L, then K/L=1/4.
- We say that Y is K intensive and X is L intensive.
- Measuring K and L intensity depends on K/L rather than the absolute amount of K and L.

FIGURE 1 Factor Intensities for Commodities X and Y in Nations 1 and 2.



- In fig. 1, Nation 1 can produce 1Y using 2K-2L, and 2Y using 4K-4L. Thus, K/L=1, this gives the slope of Y in Nation 1.
- Nation 1 can produce 1X using 1K-4L, and 2X using 2K-8L. Thus, K/L=1/4, this gives the slope of the ray of X in Nation 1.
- In Nation 2, K/L=4 for Y and 1 for X.
- Therefore, Y is the K-intensive commodity, and X is the L-intensive in Nation 2 also. This is shown by the fact that the ray from the origin for good Y is steeper than that of X in both nations.
- Even though Y is K-intensive relative to X in both nations, Nation 2 uses a higher K/L than Nation 1.
- For Y, K/L=4 in Nation 2 but K/L=1 in Nation 1.
- For X, K/L=1 in Nation 2 but K/L=1/4 in Nation 1.

- Q: Why does Nation 2 use more K-intensive production techniques in both commodities than Nation 1?
- A: Capital must be relatively cheaper in Nation 2 than in Nation 1, so that producers in Nation 2 use relatively more capital in the production of both commodities to minimize their costs of production.
- Q: But why is capital relatively cheaper in Nation 2?
- A: We must define factor abundance and examine its relationship to factor prices.
- If the price of capital falls, producers would substitute capital for labour in the production of X&Y to minimize production costs. As a result, both commodities become K-intensive. If K/L of Y exceeds K/L of X, Y is considered a K-intensive commodity.

B. Factor Abundance

- Two ways to define factor abundance:

1) In terms of physical units (i.e. overall amount of K&L (TK/TL) available to each nation.

- According to this definition, Nation 2 is capital-abundant if the ratio of the total amount of capital to the total amount of labor available in Nation 2 is greater than that in Nation 1.
- The ratio of TK/TL what is important, not the absolute amount of K&L available in each nation.
- Thus, Nation 2 can have less K than Nation 1 and still be the capital-abundant nation if TK/TL in Nation 2 exceeds TK/TL in Nation 1.

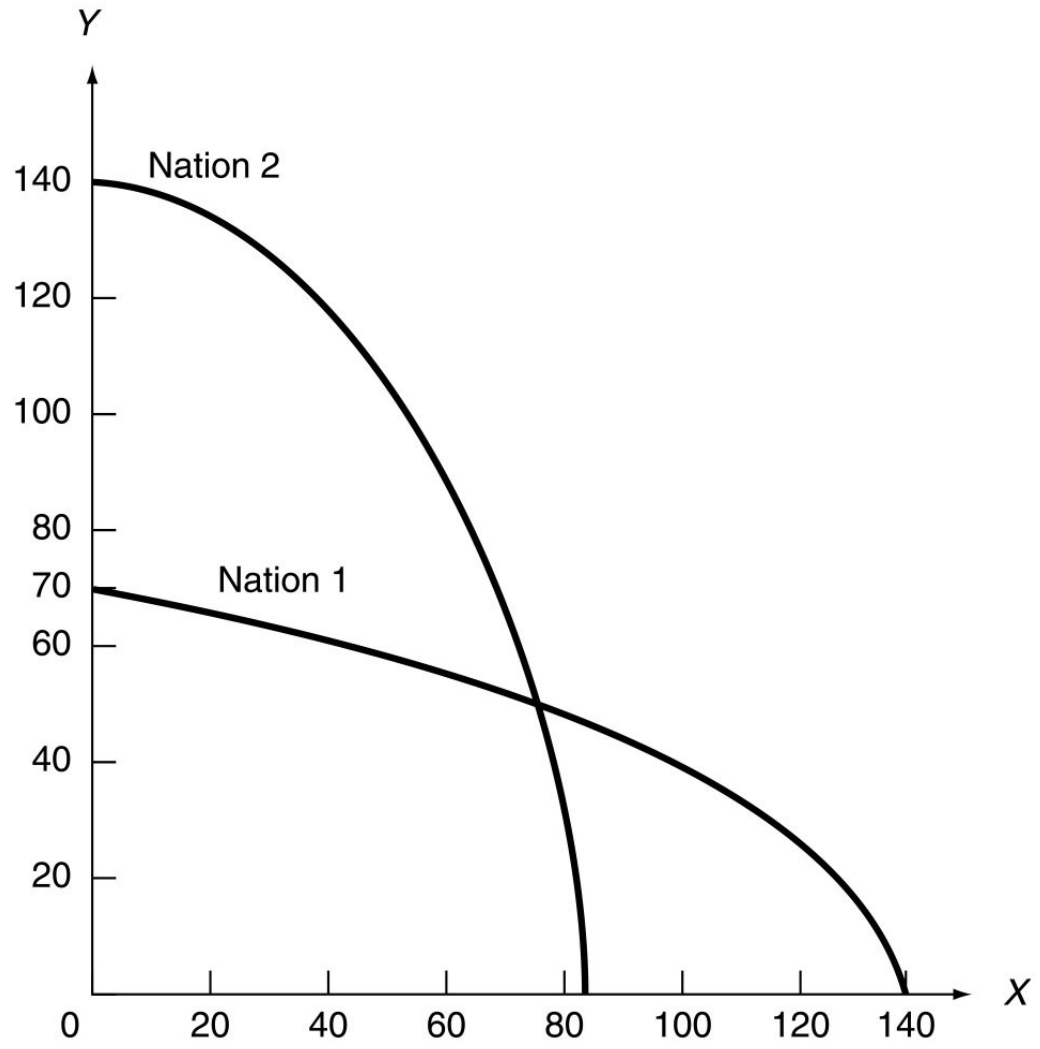
2) In terms of relative factor prices (i.e. rental price of K (P_K) and the price of L time (P_L) in each nation).

- According to this definition, Nation 2 is K abundant if (P_K/P_L) is lower in Nation 2 than in Nation 1.
- Since rental price of K is taken to be the interest rate (r) and the price of labor time is wage (w), then $P_K/P_L = r/w$.
- The ratio r/w what is important , not the absolute level of r that determines whether a nation is K abundant.
- The first definition considers only the supply of factors, while the second definition considers both demand and supply.
- The demand of the factor is derived from demand for the final commodity that requires the factor in its production.

C. Factor Abundance and the Shape of the Production Frontier

- Since Nation 2 is K-abundant and Y is K-intensive, Nation 2 can produce relatively more of Y than Nation 1.
- Since Nation 1 is L-abundant and X is L-intensive, Nation 1 can produce relatively more of X than Nation 2.
- This gives a production frontier for Nation 1 that is relatively flatter and wider that that of Nation 2.

FIGURE 2 The Shape of the Production Frontiers of Nation 1 and Nation 2.



- This means that Nation 1 exports X because X is the L-intensive commodity and L is relatively abundant and cheap factor in Nation 1.
- Nation 2 exports Y because Y is the K-intensive commodity and K is a relatively abundant and cheap factor in Nation 2.
- The H-O theorem isolates the difference in relative factor abundance, or factor endowments, among nations as the basic cause of comparative advantage and international trade.
- For this reason, it is known as factor-proportions or factor endowment theory.
- It postulates that the difference in relative factor abundance and prices is the cause of the pre-trade difference in relative commodity prices between two nations.

Illustration of the Heckscher-Ohlin Theory

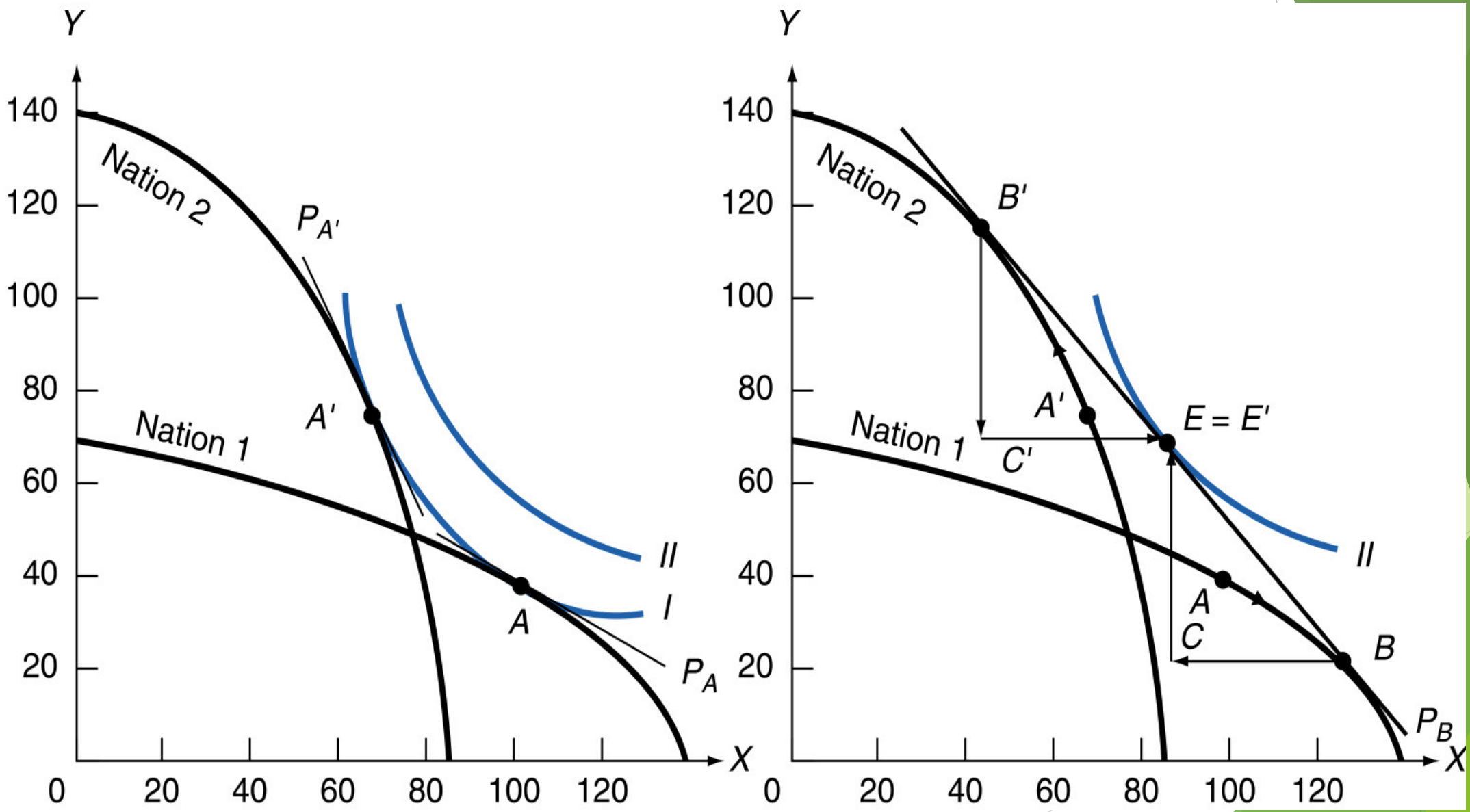


Illustration of the Heckscher-Ohlin Theory

- Since the two nations have equal tastes, they face the same indifference map.
- Indifference curve I is the highest IC that Nation 1 and Nation 2 can reach in isolation, and points A and $A^{/}$ represent their equil. points of production and consumption in the absence of trade.
- The tangency of IC I at points A and $A^{/}$ defines the no-trade equal-relative commodity prices of P_A in Nation 1 and $P_{A/}$ in Nation 2.
- Since $P_A < P_{A/}$, Nation 1 has a com-adv. in X and Nation, 2 has a com-adv. in Y.

- The right panel shows that with trade Nation 1 specializes in X and Nation 2 in Y.
- Specialization continues until Nation 1 reaches point B and Nation 2 $B^{/}$, where the transformation curves are tangent to the common relative price line P_B.
- Nation 1 exports X in exchange for Y and consume at point E on IC II. Nation 2 exports Y for X and consume at point $E^{/}$ (which coincides with point E).
- Note that Nation 1's exports of X equal Nation 2's imports of X (i.e. $BC=C^{/}E^{/}$).
- Similarly, Nation 2's exports of Y equal Nation 1's imports of Y (i.e. $B^{/}C^{/}=CE$).

- At $P_X/P_Y > P_B$, Nation 1 want to export more of X than Nation 2 wants to import at this high relative price, and P_X/P_Y falls towards P_B.
- At $P_X/P_Y < P_B$, Nation 1 want to export less of X than Nation 2 wants to import at this low relative price, and P_X/P_Y rises towards P_B.
- Point **E** involves more of Y but less of X than point **A**
- However, Nation 1 gains from trade because E is on higher IC II.
- Similarly, at $E^/$ which involves more X but less Y than $A^/$, Nation 2 is better of because $E^/$ is on higher IC II.

However, if these countries engage in trade, they can benefit from their comparative advantages of abundance factor of production

1. **Trade Outcome:**
    1. Country A specializes in producing Industry X goods and exports them to Country B.
    2. Country B specializes in producing Industry Y goods and exports them to Country A.
2. **Benefits of Trade:**
    1. Country A gains access to Industry Y goods (which it cannot efficiently produce) at a lower cost than if it tried to produce them domestically.
    2. Country B gains access to Industry X goods (which it cannot efficiently produce) at a lower cost than if it tried to produce them domestically.

- Over time, as trade continues, the model predicts that the factor prices (wages and returns on capital) between the two countries will tend to equalize. This is because trade leads to an increased demand for the abundant factor in each country, thus raising its price.
- In this example, the Heckscher-Ohlin Model helps explain why countries with differing factor endowments engage in trade.

Implication

TABLE 5.1. Factor Endowments of Various Countries as a Percentage of the World Total in 2015

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Country	**Arable Land**	**Physical Capital**	**R&D Scientists**	**Highly-Skilled Labor**	**Medium-Skilled Labor**	**Low-Skilled Labor**	**GDP**
United States	10.6%	19.5%	16.7%	10.3%	8.5%	0.0%	15.8%
Japan	0.3	9.4	8.5	4.0	2.4	0.0	4.3
Germany	0.8	4.5	4.6	2.7	2.2	1.4	3.4
United Kingdom	0.4	2.7	3.32.3	1.9	1.9	2.4	
France	1.2	3.9	3.4	2.0	1.5	0.9	2.3
Italy	0.5	2.8	1.4	1.6	1.2	0.7	1.9
Canada	3.1	2.4	2.1	1.2	0.9	0.7	1.4
Korea[a]	0.1	2.1	4.1	1.5	1.3	1.1	1.7
China	8.5	16.0	19.1	4.4	23.8	19.2	17.1
India	10.9	3.4	2.7	6.7	7.7	18.4	7.0
Russia	8.6	2.3	5.7	4.4	4.5	2.0	3.3
Brazil	5.6	2.7	2.0	1.7	1.5	1.5	2.8
Mexico	1.6	3.3	0.6	3.3	2.3	2.5	2.0
Rest of the World	47.9	25.1	25.8	54.0	40.2	49.8	27.7
World	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] Korea is now classified as an advanced economy by the International Monetary Fund.
Source: World Bank, *World Development Indicators*, 2018; *PENN World Table*, 2015; and *OECD Economic Outlook*, 2018.

TABLE 5.2. Capital Stock per Worker of Selected Countries in 2015 (in 2010 International Dollar Prices)

Developed Country	Capital Stock per Worker	Developing Country	Capital Stock per Worker
United States	$215,709	Korea[a]	$181,072
France	199,337	Turkey	128,425
Japan	194,164	Russia	93,695
Italy	182,978	China	92,029
Canada	176,042	Mexico	82,558
Germany	174,304	Thailand	63,119
Spain	163,960	Brazil	56,296
United Kingdom	131,494	India	25,030

Real-World Example of the Heckscher-Ohlin Model

- *European Union:* As predicted by its relative factor abundance, the European Union (EU-28) had a net export surplus in capital-intensive and R&D-intensive products (such as automotive products and chemicals) and
- a net import surplus in fuels and mining products, textiles and clothing, and personal and household goods.
- *Japan: In 2017,* Japan had a large net export surplus in capital-intensive and R&D-intensive products and a very large net import surplus in products intensive in natural resources and medium-and low-skilled labor—as expected from its relative factor endowments.

Heckscher Ohlin's theory of international trade in India

- When compared to its workforce, the US possesses a large amount of physical capital. India have a sizable labour force despite having little physical wealth.
- The United States has a higher ratio of total capital to labour than India. Accordingly, we may claim that the United States has more capital than India. India would be more labour-abundant than the United States because of its higher ratio of total labour to capital.
- **Trade Outcome:**

- India's labor abundance and lower labor costs position it as a global hub for outsourcing services, such as information technology (IT) services and customer support. These industries heavily rely on a skilled labor force.
- The United States specializes in producing and exporting capital-intensive goods and high-tech products, including machinery, aircraft and software.

Factor Price equalization Theorem

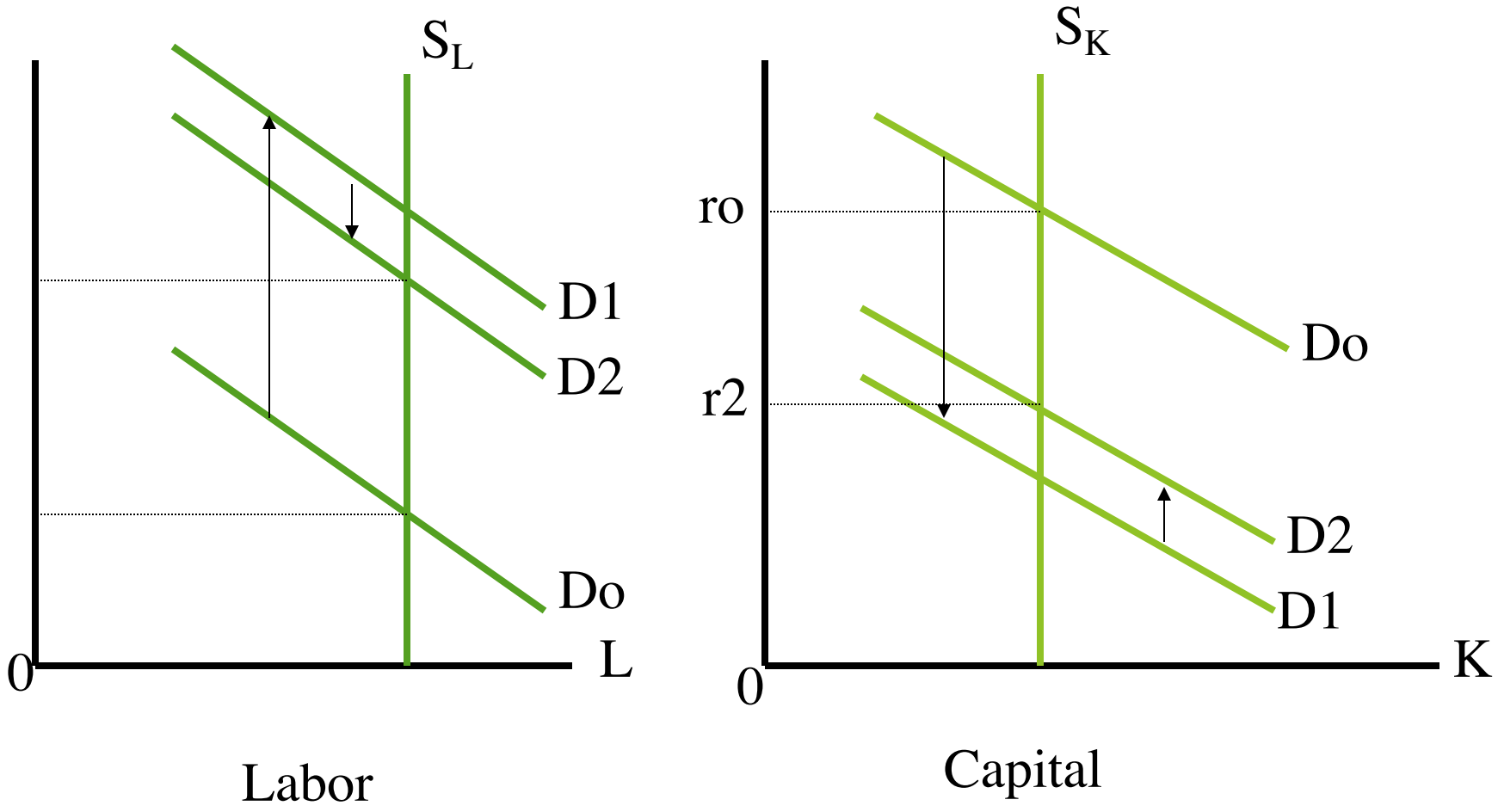
- It says that “International Trade will bring about equalization in the relative and absolute returns to homogenous factors across nations. As such, International trade is a substitute for the international mobility of factors.
- The factor-price equalization theorem was rigorously proved by Paul Samuelson (1970 Nobel prize in economics) , so it was also called H-O-S theorem.

Factor Price equalization Theorem

Production Adjustment due to International Trade

- As the production of the good using the abundant resource intensively increases, demand for that resource will increase; so will 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.

Production Adjustment due to International Trade



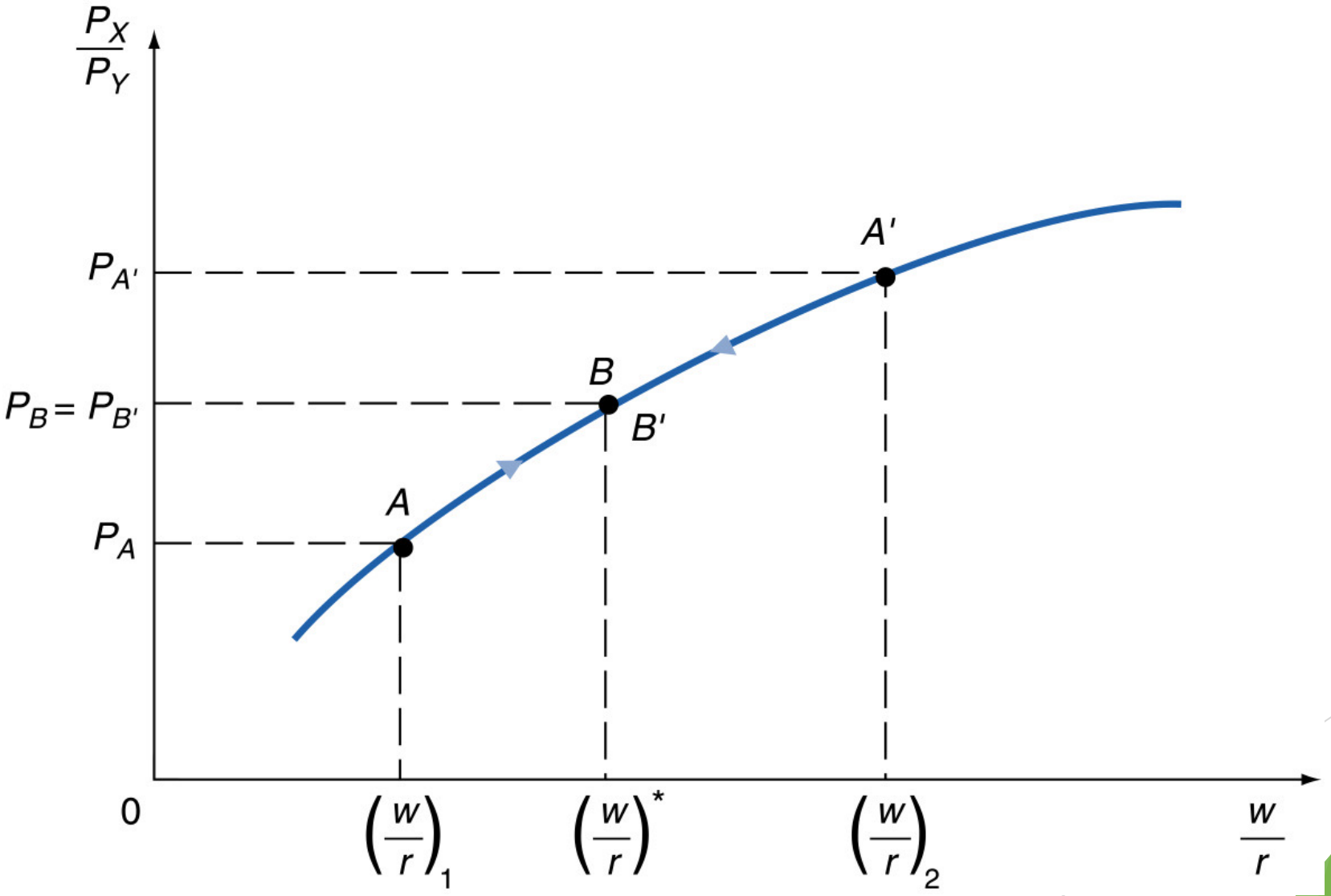
- Explanation of H-O-S theorem

1. In Nation 1 the relative price of commodity X is lower than in Nation 2, it means that the relative price of labor or wage rate is lower in Nation 1 in the absence of trade;
2. With trade, Nation 1 specializes in the production of commodity X (L-intensive commodity) and reduces its production of commodity Y(K-intensive commodity), the demand for labor rises causes the wages to rise while the relative demand for capital falls and its rate falls; on the other hand, in Nation 2 wages fall and rate rises;

- Conclusion

1. International trade *tends to reduce* the pre-trade difference in w and r between the two nations;
2. International trade keeps expanding until relative commodity prices are completely equalized, which means that relative factor prices have also become equal in two nations.

Relative and Absolute Factor-Price Equalization



- **To explain Figure**

1. The horizontal axis measures the relative price of labor (w/r) while the vertical axis measures the relative price of commodity X (PX/PY);
2. Each w/r is associated with a specific PX/PY ratio (due to the perfect competition and uses the same technology, one to one relationship between w/r and PX/PY);
3. Without trade, Nation 1 is at Point A with w/r=(w/r)1 and PX/PY=PA while Nation 2 is at Point A' with w/r=(w/r)2 and PX/PY=PA';
4. With trade, Nation 1 will produce more of commodity X due to the PA ‹PA' in the relative price of commodity X in Nation 1 than Nation 2 while Nation 2 will produce more of commodity Y .
5. With trade in Nation 1 , the increase production of commodity X, the increase demand of labor leads to the relative higher price of labor compared with the capital, w/r will rise in the end;

6. With trade in Nation 2 , the increase production of commodity Y, the increase demand of capital leads to the relative higher price of capital compared with the labor, r/w will rise (w/r will fall) in the end;

7. The upward movement in Nation 1 and downward movement in Nation 2 will continue until point B=B', at which PB=PB' and w/r=(w/r) *(only at this point both nations operate under perfection competition and use the same technology by assumption)

- **To summarize**

PX/PY will become equal as a result of trade, and this will only occur when w/r has also become equal in the two nations (as long as both nations continue to produce both commodities).

- **Absolute factor-price equalization**

It means that free international trade also equalizes the real wages for the same type of labor in the two nations and the real rate of interest for the same type of capital in the two nations.

- **Conclusion**

1. Trade equalizes the relative and absolute returns to homogeneous factors;
2. Trade acts as a substitute for the international mobility of factors of production in its effect on factor prices;
3. Trade operates on the demand for factors, factor mobility operates on the supply of factors.

- **Usefulness**

The reason is that it identifies crucial forces affecting factor prices and provides important insights into the general equilibrium nature of out trade model and of economics in general.

- **Shortcoming**

It doesn't say that international trade will eliminate or reduce international differences in *per capita incomes*. It only says that international trade will eliminate or reduce international Differences in the returns to *Homogeneous factors*.

Reason: Per capita incomes depend on other many forces (The ratio of skilled to unskilled labour and so on). Even if real Wages were to be equalized among nations, their per capita Incomes could be still wider.

Factor Abundance in Terms of Absolute Price Differences:

- The basis of international trade lies in the differences in relative commodity prices which ultimately depend upon differences in relative scarcities of factors of production in the two countries.
- Relative price differences lead to absolute price differences when a rate of exchange is fixed.

Table 1 : Exchange Rate and Factor Prices

Factors of Production	Factor Prices in		Factor Prices in England in terms of India's Currency (Rs.) when Rate of Exchange is equal to:	
	India (Rs.)	England (Pounds)	£1= Rs.20	£1= Rs.30
1	2	3	4	5
P	32	1	20	30
Q	48	2	40	60
R	56	3	60	90
S	72	4	80	120

- According to Table-1, there are four factors P, Q, R and S in both the countries India and England. Columns (2) and (3) denote factor prices in India and England stated in their respective currencies, i.e., in Rupees and Pounds.
- It is clear that in both countries, P is the cheapest, while S is the dearest factor. However, columns (2) and (3) do not indicate which of the factors is relatively cheaper or dearer in the two countries.
- When the rate of exchange is £1 = Rs. 20, the factor prices of England in terms of India's currency is expressed in column (4).
- Thus, in the first case, India will concentrate on the production of those goods which use a large amount of factors R and S, while England will produce goods requiring more use of factors P and Q.
- In the second case, however, England can produce relatively cheaply only those goods which require more employment of factor P, while India can produce all other goods containing factors, Q, R and S more cheaply.