International Trade

L9

Factor Endowments and The Heckscher–Ohlin Theory

Heckscher-Ohlin Theory: 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 labor 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.

Factor Intensity

- Assuming 2 commodities (X and Y) and 2 factors (K and L)
- Y is capital intensive , if **capital-labor ratio (K/L)** used in the production of Y is greater than K/L used in the production of X
- It is not the *absolute* amount of capital and labor used in the production of commodities X and Y that is important in measuring the capital and labor intensity of the two commodities, but the amount of **capital *per unit of labor*** (i.e., *K*/*L*).
- Eg: To produce 1 unit of X (1X) , Nation 1 requires 5 units of K and 20 units of L (5K and 20L).To produce 1Y, Nation 1 requires 2K and 2L. Then which is more capital- intensive product?

Factor Intensity

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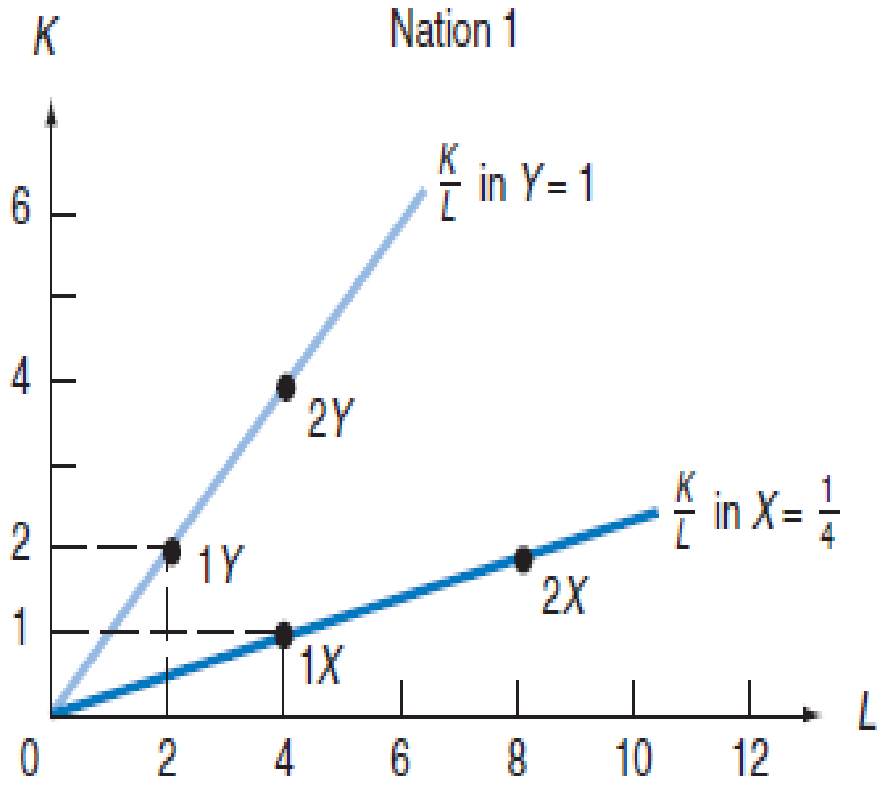
- 1X needs 5K versus 1Y needs 2K. Then is X the capital-intensive product relative to Y
- Ans: We need to consider the K/L ratio rather than absolute use of capital to measure K intensity
- Then 1X, K/L ratio=5K/20L=1/4 ; whereas 1Y=2K/2L= 1.
- That means K/L of X (1/4)< K/L of Y (1).
- Hence Y is the more K intensive commodity

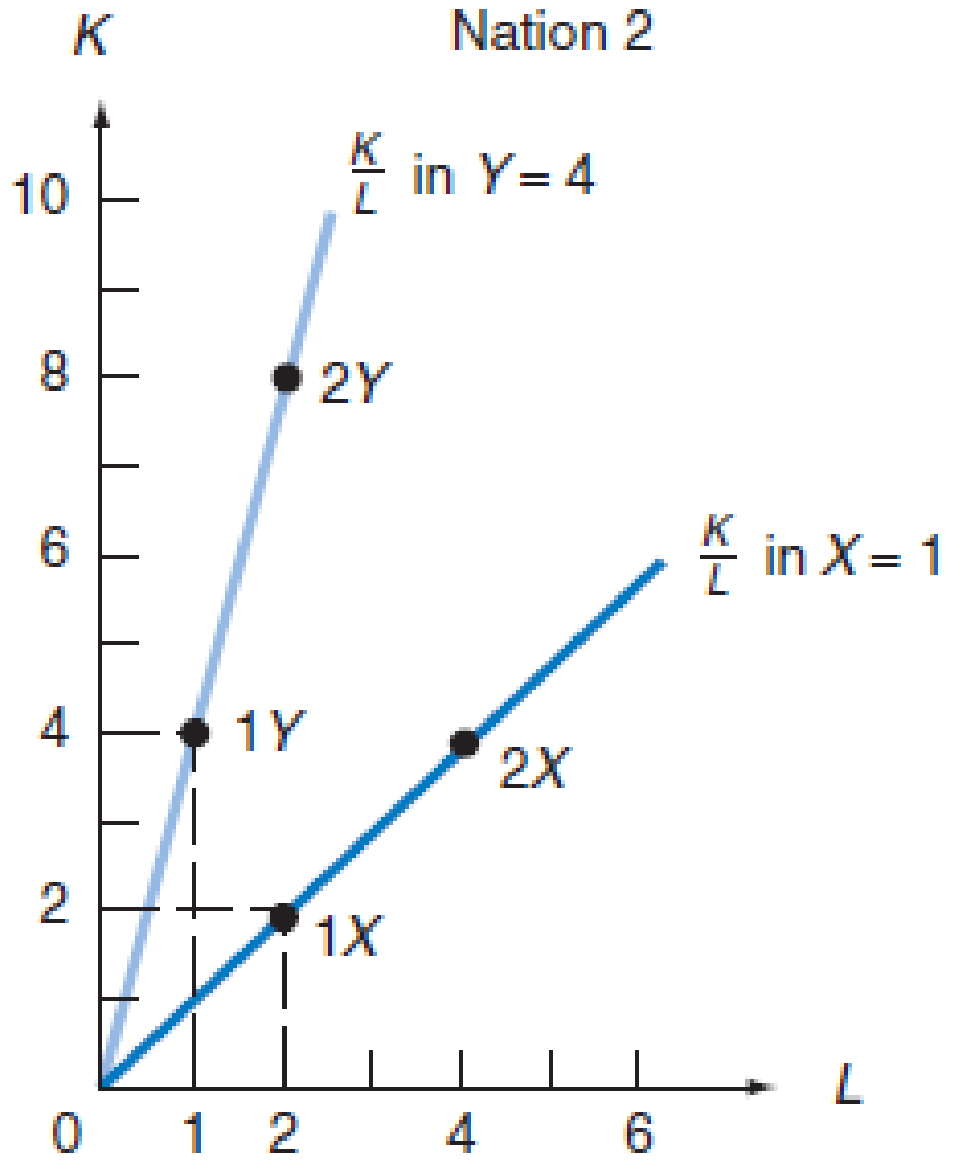
Factor Intensities for X and Y in Nation 1

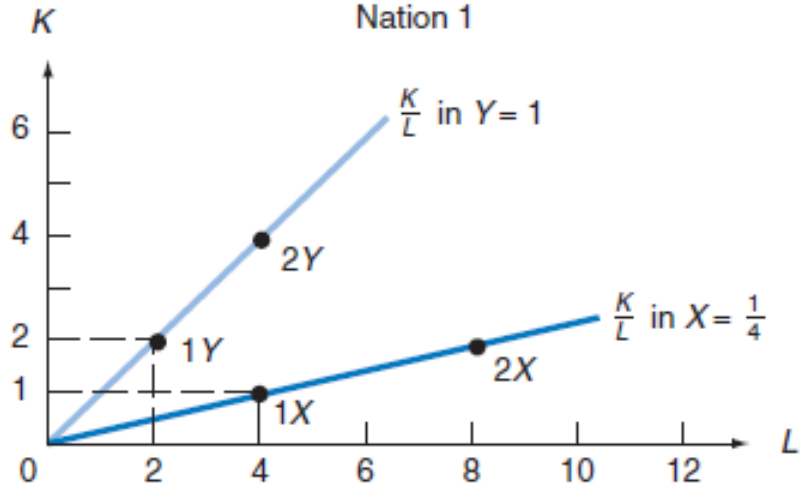
- Production took place along a straight-line ray from the origin. Slope of the line would measure the capital-labor ratio (K/L) in the production of respective commodity
- K/L for Y= 1 (Slope of production line forY)
- K/L for X=1/4 (Slope of production line for X)
- 1Y= F(2K, 2L);
- CRS ensures F(4K,4Y)=2Y
- Similarly 1X=F(1K, 4L), 2X=F(2K,8L)

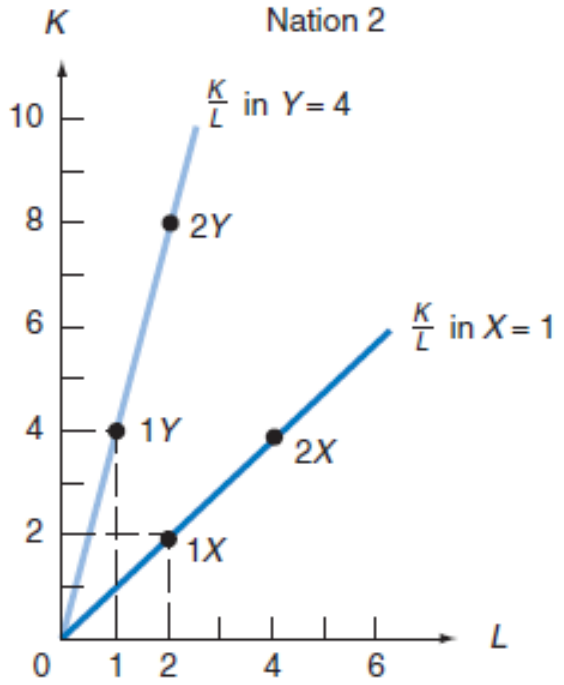


Factor Intensities for X and Y in Nation 2

- Production took place along a straight-line ray from the origin. Slope of the line would measure the capital-labor ratio (K/L) in the production of respective commodity
- K/L for Y= 4 (Slope of production line forY)
- K/L for X=1 (Slope of production line for X)
- 1Y= F(4K, 1L);
- CRS ensures F(8K,2Y)=2Y
- Similarly 1X=F(2K, 2L), 2X=F(4K,4L)





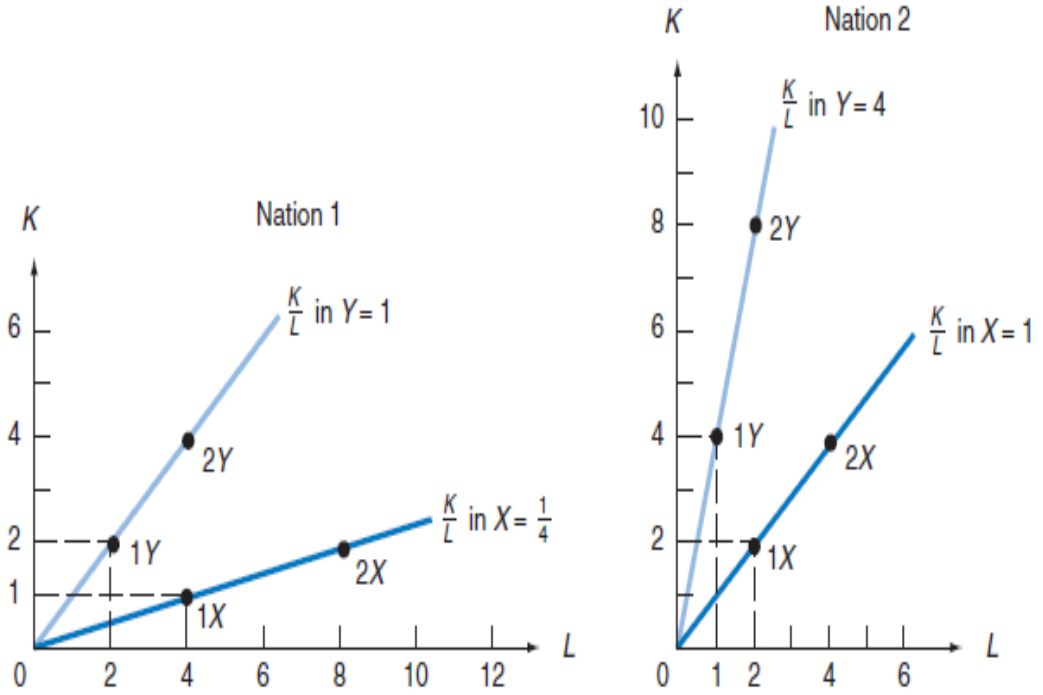


Factor intensity

- Even though commodity Y is *K* intensive in relation to commodity X in both nations,
- *Nation 2 uses a higher K/L* in producing both Y and X 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.

Factor intensity

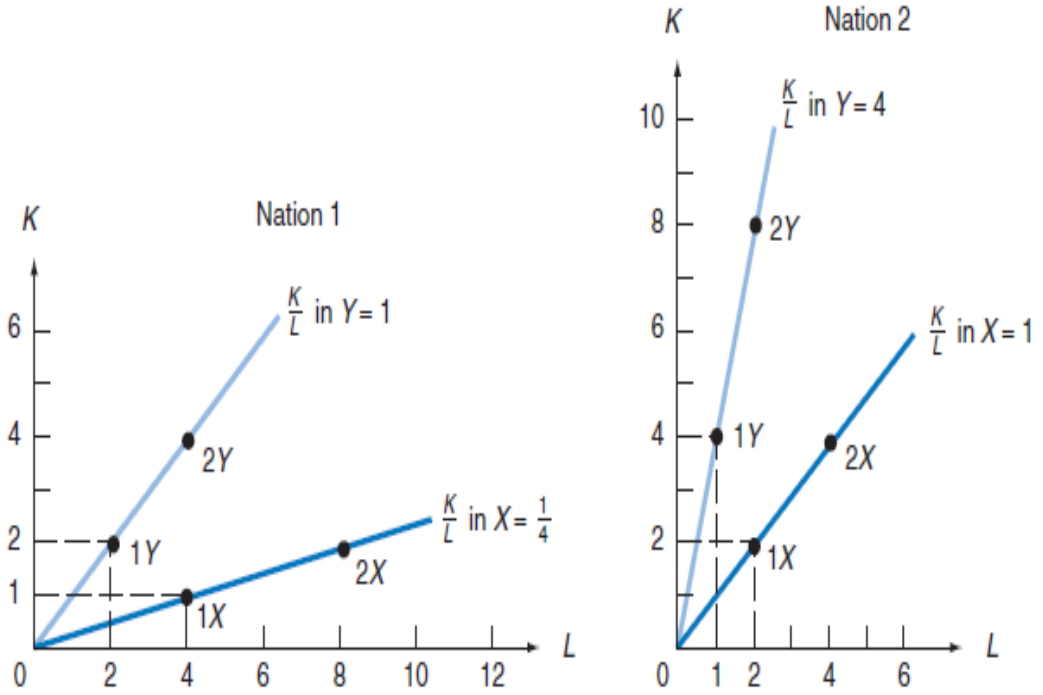
Why does Nation 2 use more *K*-intensive production techniques in both commodities than Nation 1?



Factor intensity

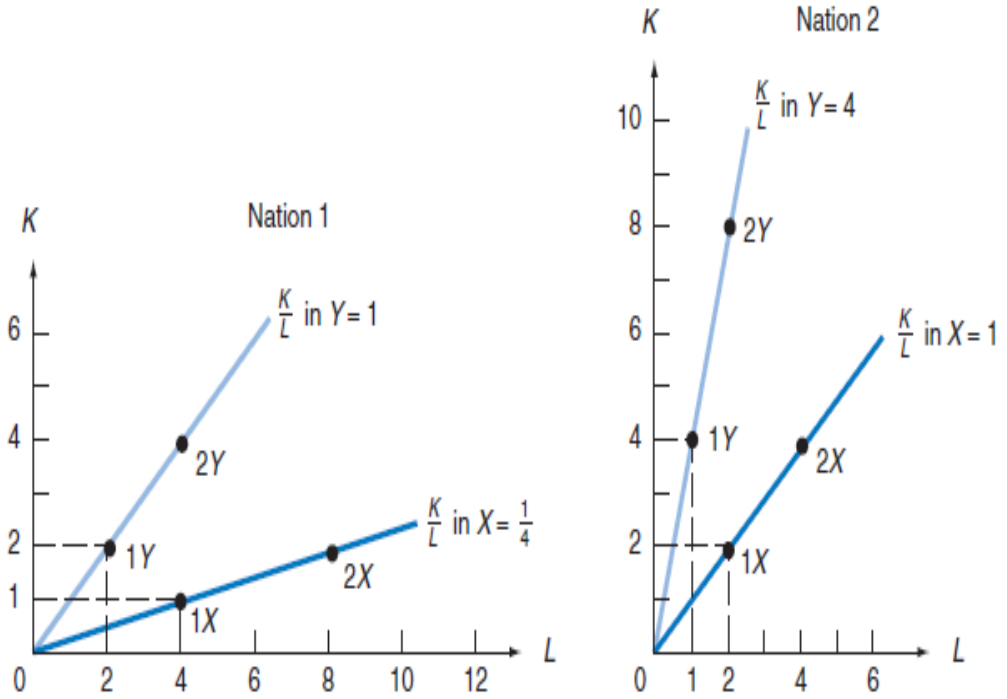
Why does Nation 2 use more *K*-intensive production techniques in both commodities than Nation 1?

The answer is that **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.**



Factor intensity

- Why does Nation 2 use more *K*-intensive production techniques in both commodities than Nation 1?
- The answer is that **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.**
- But why is capital relatively cheaper in Nation 2? To answer this question, we must define factor abundance (endowments) and examine its relationship to factor prices.



Factor intensity

- What happens if, for whatever reason, the relative price of capital falls.
- Producers would substitute capital for labor in the production of both commodities to minimize their costs of production.
- As a result, both commodities would become more *K* intensive.
- **However, only if *K*/*L* in the production of commodity Y exceeds *K*/*L* in the production of commodity X *at all possible relative factor prices* can we say that commodity Y is the *K*-intensive commodity**

Factor abundance

Factor abundance -How to define it?

- One way is in terms of physical *units* (i.e., in terms of the overall amount of capital and labor available to each nation).
- Another way to define factor abundance is in terms of relative factor prices
  - i.e., in terms of the rental price of capital and the price of labor time in each nation.

Factor abundance: Physical units

- According to the definition in terms of physical units, Nation 2 is **capital abundant if the ratio of the total amount of capital to the total amount of labor (*TK/TL*) available** in Nation 2 **is *greater*** than that in Nation 1 (i.e., if *TK/TL* for Nation 2 exceeds *TK/TL* for Nation 1).
- **Note that it is not the absolute amount of capital and labor available in each nation that is important but the *ratio* of the total amount of capital to the total amount of labor.**
- Thus, Nation 2 can have less capital than Nation 1 and still be the capital-abundant nation if *TK/TL* in Nation 2 exceeds *TK/TL* in Nation 1.

Factor abundance: Relative factor prices

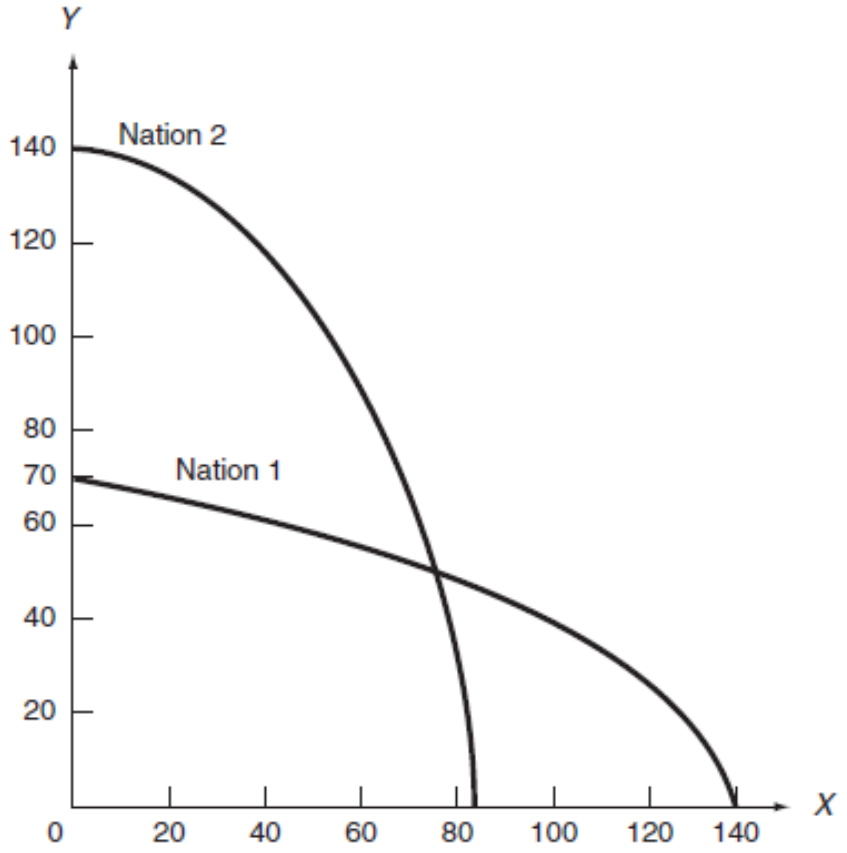
- According to the definition in terms of factor prices, Nation 2 is capital abundant if the **ratio of the rental price of capital to the price of labor time (*PK* /*PL*)** is ***lower*** in Nation 2 than in Nation 1 (i.e., if *PK* /*PL* in Nation 2 is smaller than *PK* /*PL* in Nation 1).
- Since the rental price of capital is usually taken to be the interest rate (*r*) while the price of labor time is the wage rate (*w*), *PK* /*PL*= *r*/*w*.
- Once again, **it is not the absolute level of *r* that determines whether or not a nation is the *K*-abundant nation, but *r*/*w*.**
- For example, *r* may be higher in Nation 2 than in Nation 1, but Nation 2 will still be the *K*-abundant nation if
- *r*/*w* is lower there than in Nation 1.

Factor abundance and Shape of PPF

Since Nation 2 is the *K*-abundant nation and commodity Y is the *K*-intensive commodity, Nation 2 can produce *relatively* more of commodity Y than Nation 1.

On the other hand, since Nation 1 is the *L*-abundant nation and commodity X is the *L*-intensive commodity, Nation 1 can produce relatively more of commodity X than Nation 2.

This gives a production frontier for Nation 1 that is relatively flatter and wider than the production frontier of Nation2 (if we measure X along the horizontal axis).



Factors of Production: Endowment/abundance

Arable land is the general resource to produce agriculturalproducts;

Physical capital refers to machinery,factories, and other nonhuman means of production;

R&D scientists refers to the most highly skilled

labor with more than tertiary (college) education and used to produce the most highly technological products; highly skilled labor is labor that has completed tertiary or college education; unskilled abor is labor that has no education beyond primary education.

TABLE 5.1. Factor Endowments of Various Countries as a Percentage of the World Total in 2006

Country	(1) Arable Land	(2) Physical Capital	(3) R&D Scientists	(4) Highly Skilled Labor	(5) Medium-Skilled Labor	(6) Unskilled Labor	(7) GDP
United States	12.2%	22.0%	24.1%	22.2%	7.5%	0.4%	21.9%
Japan	0.3	14.1	12.3	10.3	4.2	0.2	7.0
Germany	0.8	6.8	4.9	4.4	3.3	0.5	4.5
United Kingdom	0.4	2.8	3.2	3.4	2.2	0.1	3.4
France	1.3	4.4	3.5	3.1	1.9	0.1	3.3
Italy	0.5	3.5	1.4	1.5	2.3	0.3	2.8
Canada	3.2	3.0	2.2	3.1	0.9	0.1	2.0
China	10.1	11.1	21.1	5.9	25.6	24.9	10.2
India	11.2	4.9	1.6	5.9	9.2	21.7	4.5
Russia	8.5	2.3	8.1	2.8	6.6	0.1	3.0
Brazil	4.2	2.9	1.5	2.6	3.2	2.9	2.7
Korea	0.1	3.3	3.5	2.6	1.7	1.3	1.7
Mexico	1.8	2.0	0.8	3.2	1.5	0.2	2.1
Rest of the World	45.4	16.7	11.7	29.0	28.4	47.2	30.7
World	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Factors of Production: Endowment/abundance

A nation is broadly defined as having a relative abundance of those factors for which its share of the world availability of that factor exceeds the nation's share of world output (GDP in terms of purchasing power).

India – Factor abundance- land, physical capital, labor (all types)

Japan- Factor abundance- capital (capital-intensive products) , R&D, high skilled labour

US- R&D, high skilled labor, Capital

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France	1.3	4.4	3.5	3.1	1.9	0.1	3.3
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Capital labor ratio

Ex: US K/L lower than industrial/developed countries but higher than developing countries.

Inference: US has a comparative advantage in K-intensive products with respect to developing countries but not with respect to other developed countries

TABLE 5.2. Capital Stock per Worker of Selected Countries in 2006 (in 1990 International Dollar Prices)

Developed Country	Capital Stock per Worker	Developing Country	Capital Stock per Worker
Japan	$111,615	Korea	$45,235
Canada	89,652	Mexico	23,921
Germany	87,400	Turkey	20,478
France	85,097	Brazil	16,650
Italy	73,966	Russia	16,131
United States	73,282	Thailand	11,688
Spain	51,814	China	7,485
United Kingdom	44,545	India	5,870

H-O Theorem

- Starting with the assumptions, we can state 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.
- Of all the possible reasons for differences in relative commodity prices and comparative advantage among nations, **the H–O theorem isolates the difference in relative factor abundance, or *factor endowments*, among nations as the basic cause or determinant of comparative advantage and international trade.**
- **For this reason, the H–O model is often referred to as the factor-proportions or factor-endowment theory**.
- The H–O theorem postulates that **the difference in relative factor abundance and prices is the *cause* of the pretrade difference in relative commodity prices between two nations**.

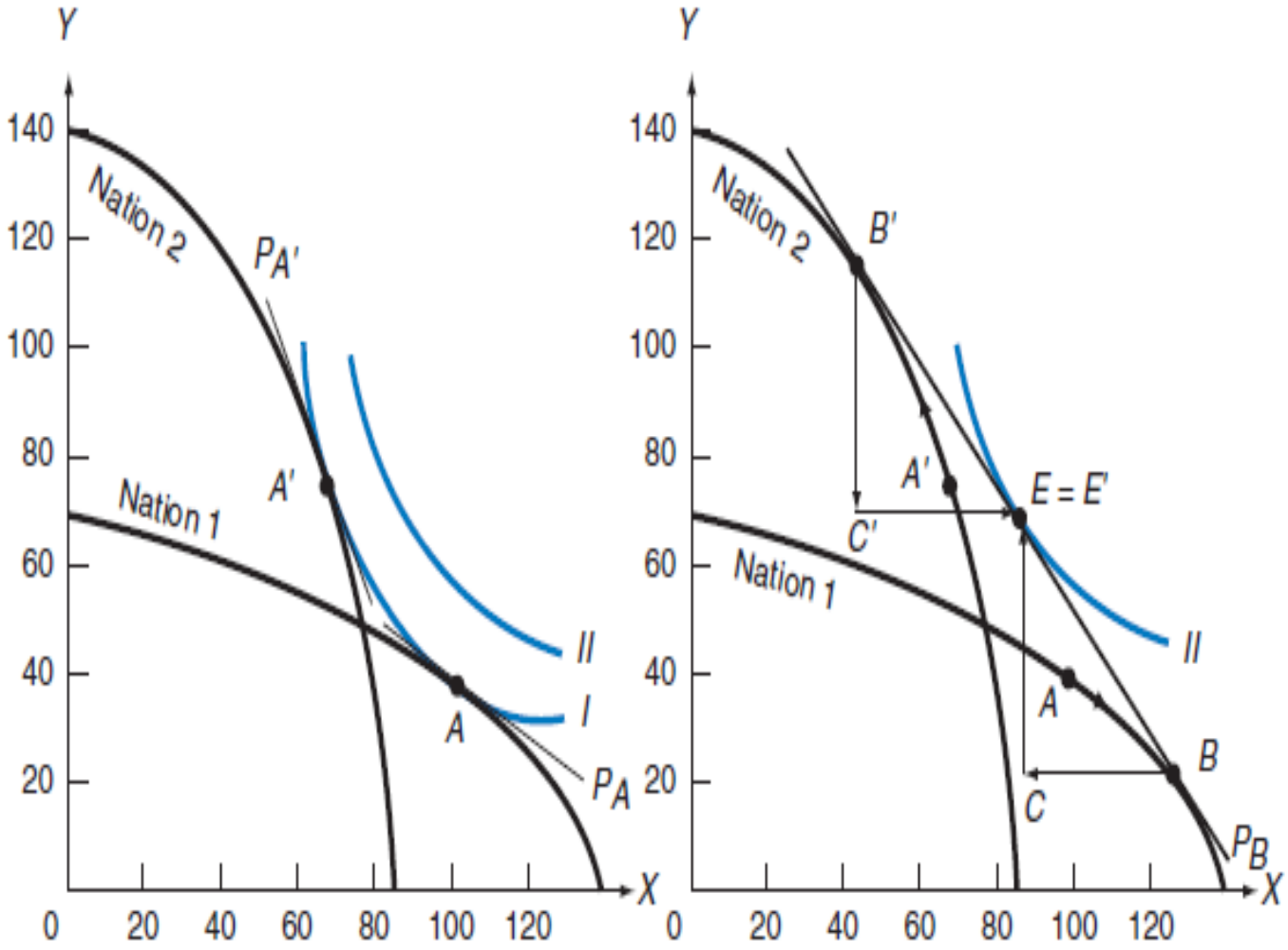
H-O Theorem

- The H–O theorem postulates that **the difference in relative factor abundance and prices is the *cause* of the pretrade difference in relative commodity prices between two nations**.
- This difference in *relative* factor and *relative* commodity prices is then translated into a difference in *absolute* factor and commodity prices between the two nations.
- It is **this difference in absolute commodity prices in the two nations that is the *immediate* cause of trade.**

H-O theorem

Indifference curve I is common to both nations because of the assumption of equal tastes.

Indifference curve I is tangent to the production frontier of Nation 1 at point A and tangent to the production frontier of Nation 2 at A’ . This defines the **no-trade equilibrium-relative commodity price of PA in Nation 1 and PA’ in Nation 2** (see the left panel).

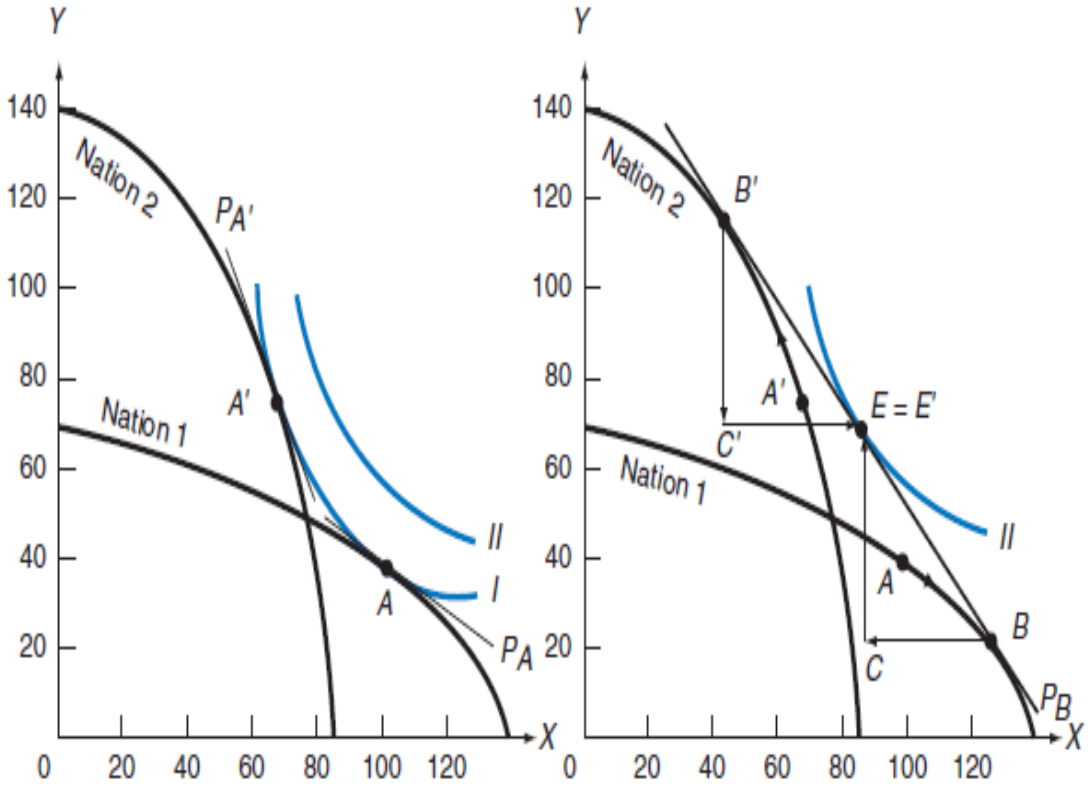


Since PA < PA’ , Nation 1 has a comparative advantage in commodity X and Nation 2 in commodity Y.

With trade (see the right panel) Nation 1 produces at point B and by exchanging X for Y reaches point E in consumption (see trade triangle BCE).

Nation 2 produces at B and by exchanging Y for X reaches point E (which coincides with E).

Both nations gain from trade because they consume on higher indifference curve II.

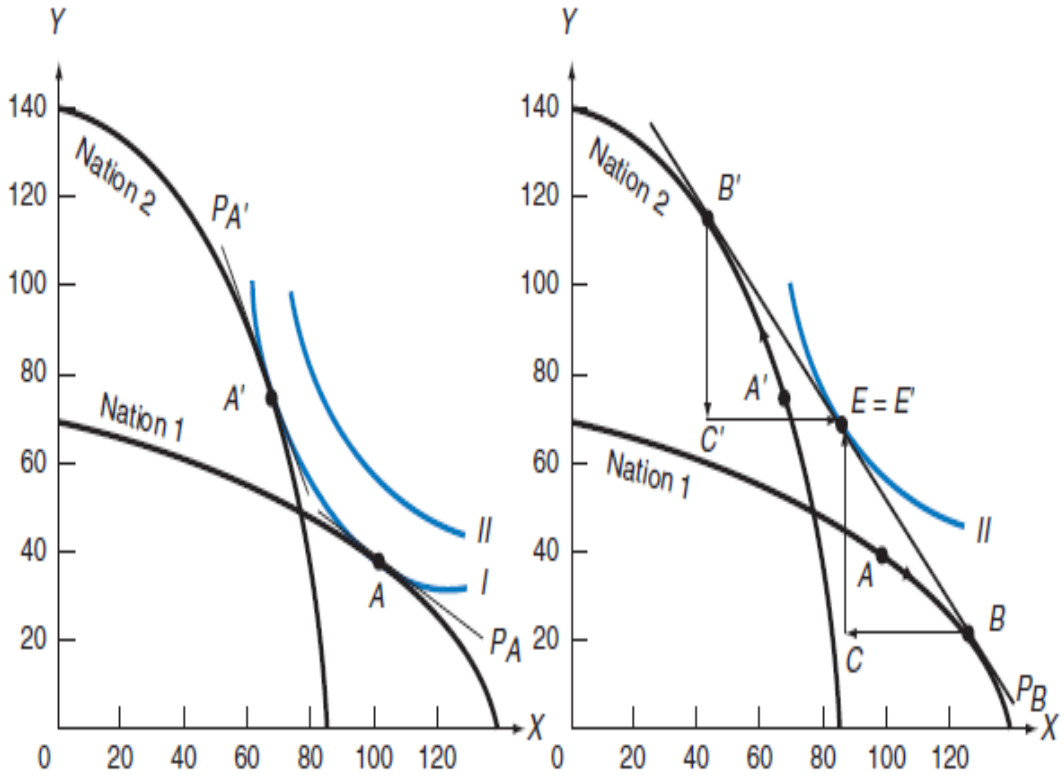


Note also that the H–O theory does not require identical tastes (i.e., equal indifference

curves) in the two nations. It only requires that if tastes differ, they do not differ sufficiently to

neutralize the tendency of different factor endowments and production possibility curves from

leading to different relative commodity prices and comparative advantage in the two nations.



Factor-price equalization Theorem

- *International trade will bring about equalization in the relative and absolute returns to homogeneous factors across nations*
- *Factor–price equalization theorem*, which is really a corollary, since it follows directly from the H–O theorem and holds only if the H–O theorem holds. It was ***Paul Samuelson*** (1970 Nobel prize in economics) who rigorously proved this corollary. For this reason, it is sometimes referred to as the Heckscher–Ohlin–Samuelson theorem (H–O–S theorem)

Factor-price equalization Theorem

- **The international trade will cause the wages of homogeneous labor (**i.e., labor with the same level of training, skills, and productivity**) to be the same in all trading nations** (if all of the assumptions of H-O Theorem holds).
- Similarly, **international trade will cause the return to homogeneous capital** (i.e., capital of the same productivity and risk) **to be the same in all trading nations**.
- That is, international trade will make *w* the same in Nation 1 and Nation 2;
- similarly, it will cause *r* to be the same in both nations. Both relative and absolute factor prices will be equalized.

Factor-price equalization Theorem

- In the absence of trade the relative price of commodity X is lower in Nation 1 than in Nation 2 because the relative price of labor, or the wage rate, is lower in Nation 1.
- As Nation 1 specializes in the production of commodity X (the *L*-intensive commodity) and reduces its production of commodity Y (the *K*-intensive commodity), the relative demand for labor rises, causing wages *(w)* to rise, while the relative demand for capital falls, causing the interest rate *(r)* to fall.

- The exact opposite occurs in Nation 2. That is, as Nation 2 specializes in the production of Y and reduces its production of X with trade, its demand for *L* falls, causing *w* to fall, while its demand for *K* rises, causing *r* to rise.

Factor-price equalization Theorem

- To summarize, international trade causes *w* to rise in Nation 1 (the low-wage nation) and to fall in Nation 2 (the high-wage nation).
- Thus, **international trade reduces the pre-trade difference in *w* between the two nations. Similarly, international trade causes *r* to fall** in Nation 1 (the *K*-expensive nation) and to rise in Nation 2 (the *K*-cheap nation), thus reducing the pretrade difference in *r* between the two nations.
- This proves that international trade ***tends to reduce*** the pre-trade difference in *w* and *r* between the two nations.