

Lecture 4c:

Stolper-Samuelson Theorem

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C181 – International Trade

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3- Effect of trade on factor prices

IN THE SPECIFIC-FACTOR MODEL

Assume that the computer industry only use capital and that the shoe industry only use labor.

If the price of computers increases with trade:

- a) Workers and capital owners **all gains** from trade but **capital owners gain more**
- b) Workers and capital owners **all gains** from trade but **workers gain more**
- c) Capital owners gain from trade and **workers lose**
- d) Workers gain from trade and **capital owners lose**

3- Effect of trade on factor prices

IN THE SPECIFIC-FACTOR MODEL

We have shown (see chapter 3):

c) Capital owners gain from trade and **workers lose**

Now, today the key question is:

Does the same result hold when both industries use K and L and factors are mobile? (=HO model)

3- Effect of trade on factor prices

(Continuation of chapter 4)

Stolper-Samuelson Theorem

Within the Heckscher-Ohlin framework:

3- Effect of trade on factor prices

(Continuation of chapter 4)

Stolper-Samuelson Theorem

Within the Heckscher-Ohlin framework:

- What is the effect of trade on wages?
(adjusting for prices, i.e. looking at welfare)
- What is the effect of trade on the rental rate?

3- Effect of trade on factor prices

(Continuation of chapter 4)

Stolper-Samuelson Theorem

Within the Heckscher-Ohlin framework:

- What is the effect of trade on wages?
(adjusting for prices, i.e. looking at welfare)
- What is the effect of trade on the rental rate?
- What is the effect of trade on the wage/rental rate ratio?
 - Focus first on wage/rental rate ratio
 - Focus first on relative demand & supply of labor/capital

3- Effect of trade on factor prices

Relative demand for Capital and Labor:

What is the relative *supply* of labor at Home?

3- Effect of trade on factor prices

Relative demand for Capital and Labor:

What is the relative *supply* of labor at Home?

What is the relative *demand* for labor at Home?

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Relative demand for Capital and Labor:

What is the relative *supply* of labor at Home?

What is the relative *demand* for labor at Home?

$$\underbrace{\frac{\bar{L}}{\bar{K}}}_{\text{Relative supply}} = \frac{L_C + L_S}{\bar{K}} = \underbrace{\frac{L_C}{K_C} \cdot \left(\frac{K_C}{\bar{K}}\right) + \frac{L_S}{K_S} \left(\frac{K_S}{\bar{K}}\right)}_{\text{Relative demand}}$$

3- Effect of trade on factor prices

Relative demand for Capital and Labor:

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Relative *demand* for labor determined by:

- Labor intensity in each industry: L_C/K_C and L_S/K_S
 - Industry shares in capital use: K_C/\bar{K} and K_S/\bar{K}
- ➔ Relative demand for labor = Average of labor intensities, weighted by the share of each industry in capital use.

Relative demand for Capital and Labor:

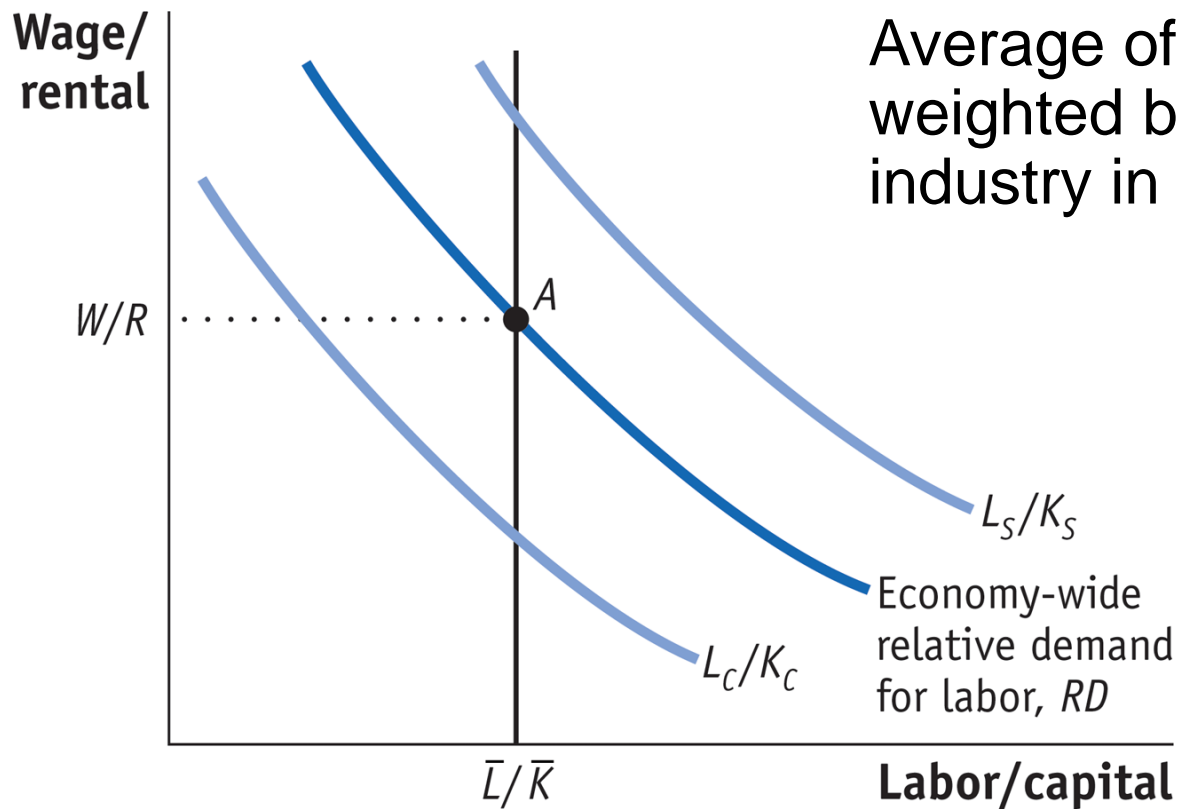
$$\underbrace{\frac{\bar{L}}{\bar{K}}}_{\text{Relative supply}} = \underbrace{\frac{L_C}{K_C} \cdot \left(\frac{K_C}{\bar{K}}\right) + \frac{L_S}{K_S} \cdot \left(\frac{K_S}{\bar{K}}\right)}_{\text{Relative demand}}$$

- L_C/K_C and L_S/K_S : Labor intensity in each industry
(correspond to each light-blue curve)
 - K_C/K_{tot} : Share of Computer industry total K use
= weight put on Computer industry
 - K_S/K_{tot} : Share of Computer industry total K use
= $1 - (K_C/K_{\text{tot}})$
- ➔ Relative demand for labor = Average of labor intensities, weighted by the share of each industry in capital use.

3- Effect of trade on factor prices

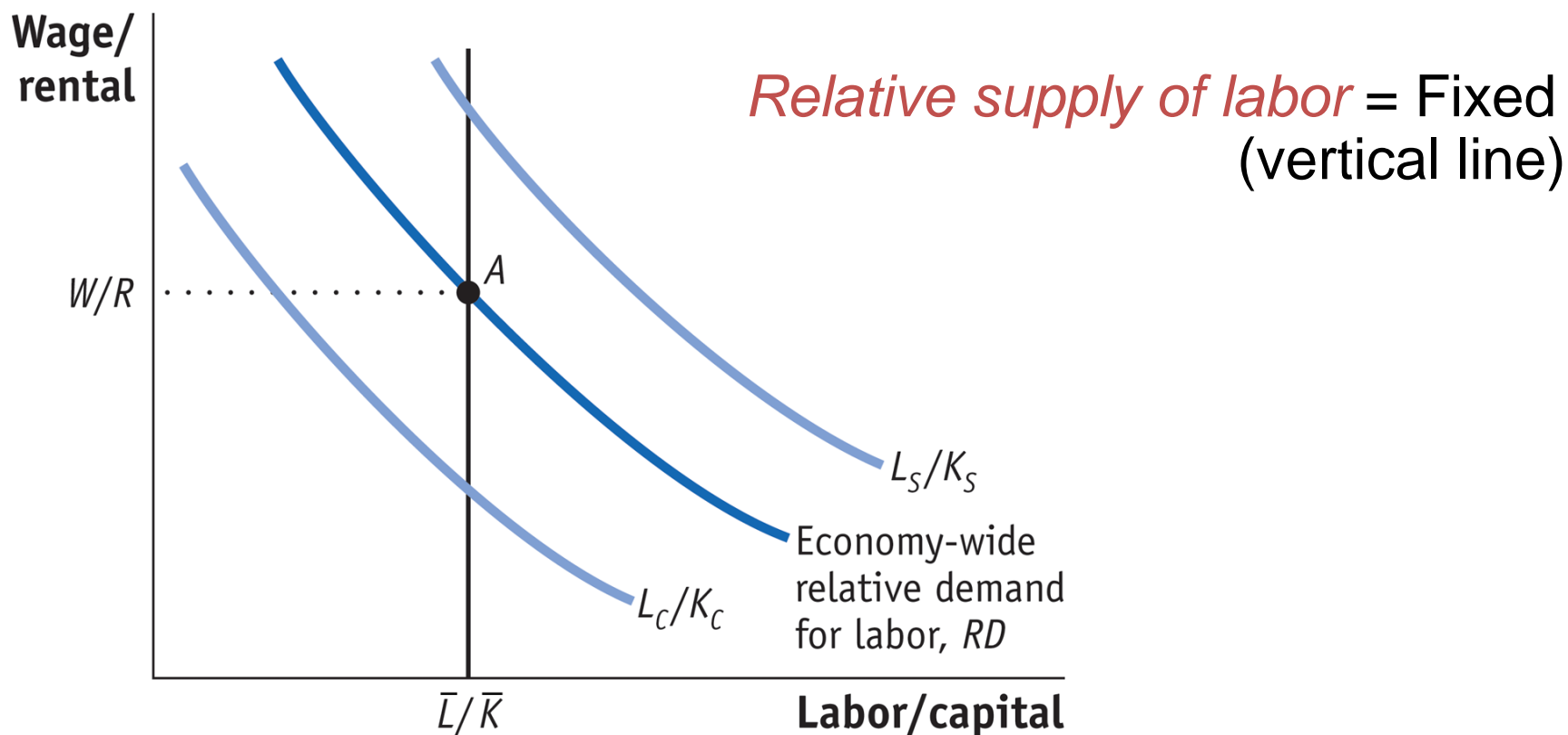
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3- Effect of trade on factor prices

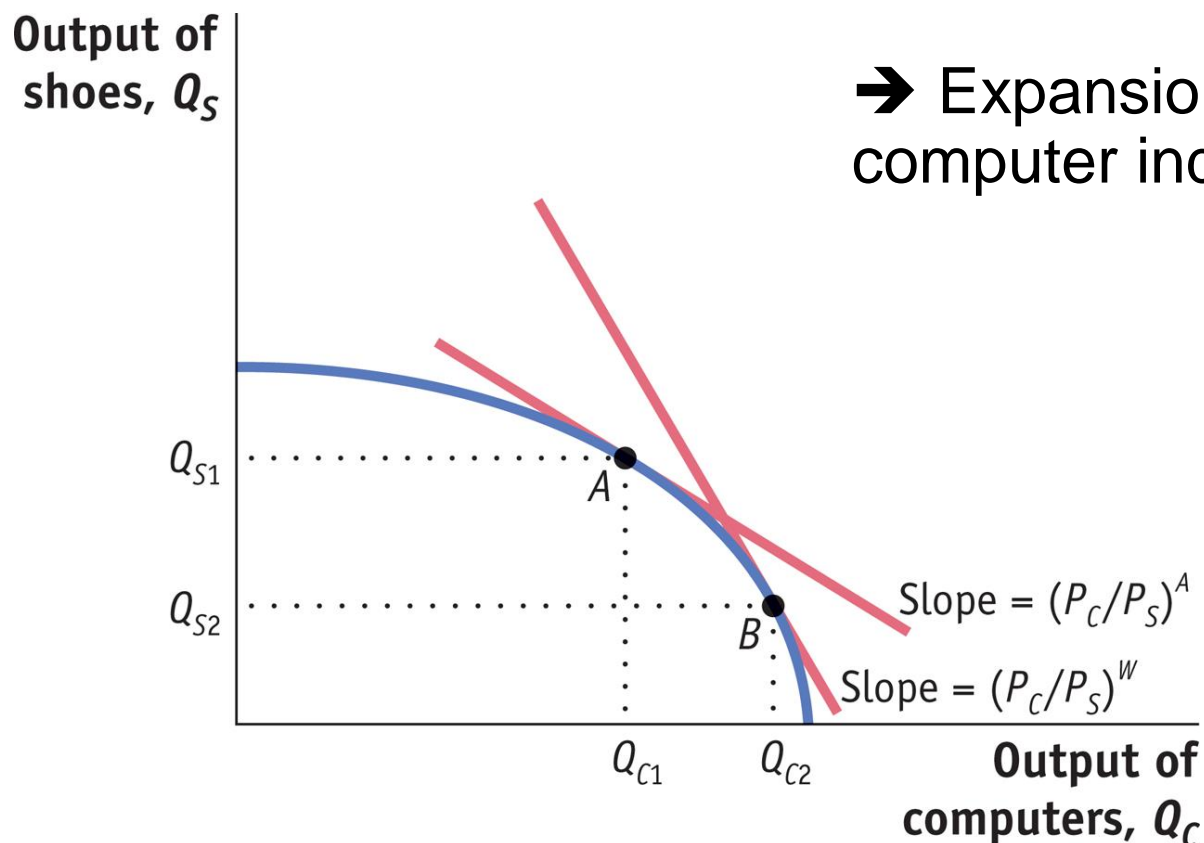
Relative supply of Capital and Labor:



3- Effect of trade on factor prices

Effect of trade

(Effect of an increase in the Relative Price of Computers)



3- Effect of trade on factor prices

Relative demand for Capital and Labor:

$$\underbrace{\frac{\bar{L}}{\bar{K}}}_{\text{Relative supply}} = \frac{L_C + L_S}{\bar{K}} = \underbrace{\frac{L_C}{K_C} \cdot \left(\frac{K_C}{\bar{K}}\right) + \frac{L_S}{K_S} \left(\frac{K_S}{\bar{K}}\right)}_{\text{Relative demand}}$$

A shift towards the computer industry leads to:

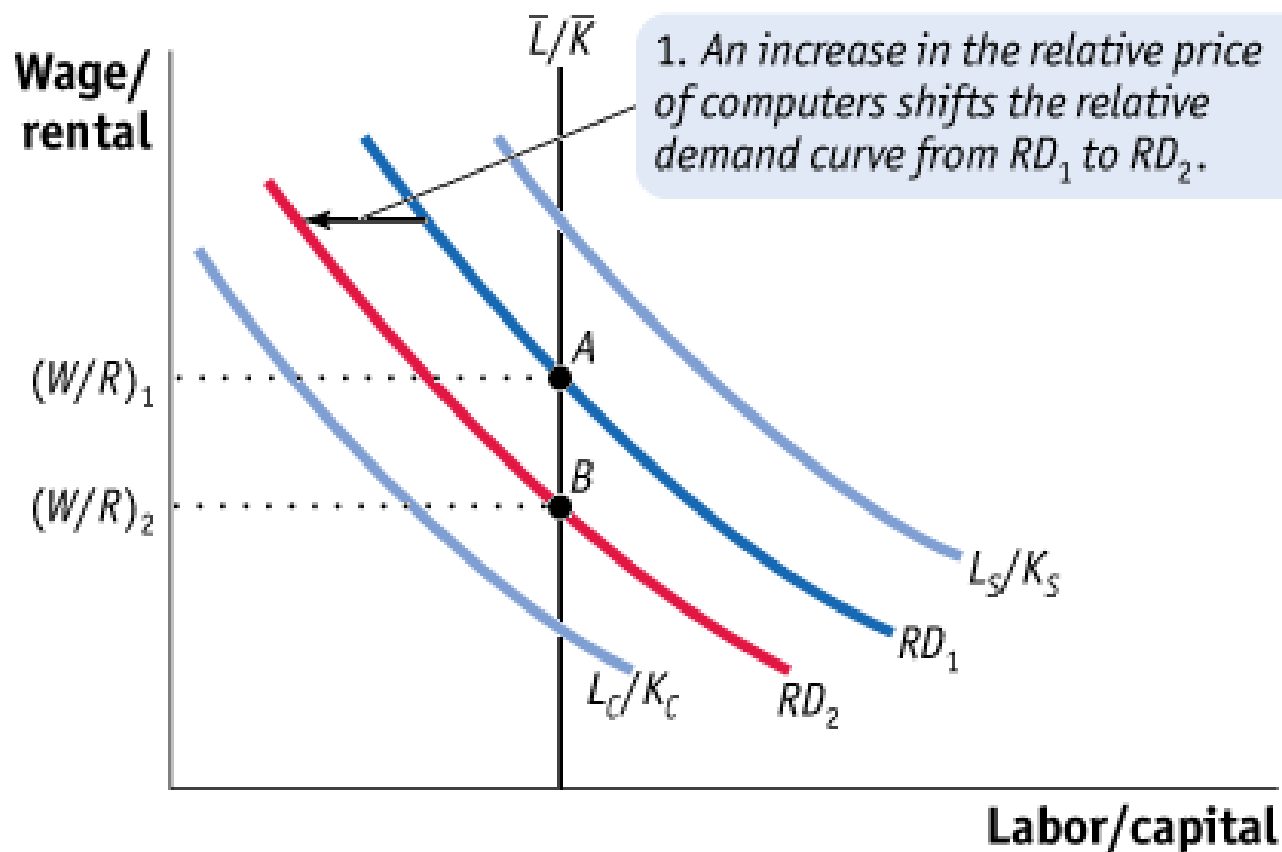
- An increase in computer industry capital share K_C/K
- An decrease in shoe industry capital share K_S/K

➔ ***Decrease in relative demand for labor***

3- Effect of trade on factor prices

Effect of Trade

(Effect of an increase in the Relative Price of Computers)



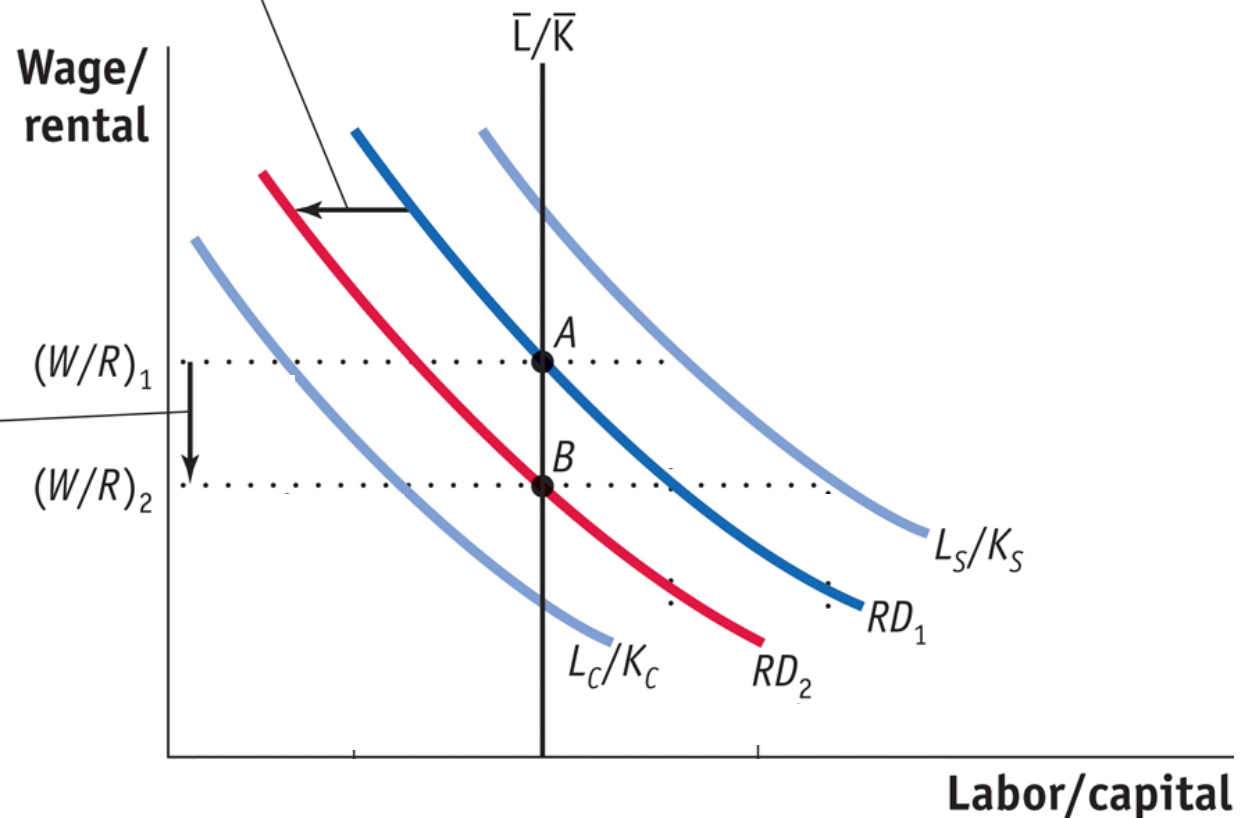
3- Effect of trade on factor prices

Effect of Trade

(Effect of an increase in the Relative Price of Computers)

1. An increase in the relative price of computers shifts the relative demand curve from RD_1 to RD_2 .

2. The relative wage decreases from $(W/R)_1$ to $(W/R)_2$.



3- Effect of trade on factor prices

Effect of trade

At Home, opening to trade induces:

- An increase in the relative price of computers
- An expansion of the computer industry
- A decrease of the demand for labor
- A decrease in the wage/rental-rate ratio

3- Effect of trade on factor prices

Examples:

- Taking the production function from last lecture, with $\beta = 2/3 > \alpha = 1/3$

- Shoe: $Y_S = a_S L_S^{2/3} K_S^{1/3} \Rightarrow \frac{L_S}{K_S} = 2 \left(\frac{w}{r} \right)^{-1}$
- Computer: $Y_C = a_C L_C^{1/3} K_C^{2/3} \Rightarrow \frac{L_C}{K_C} = \frac{1}{2} \left(\frac{w}{r} \right)^{-1}$

Effect of trade on rental rate / w ratio?

Examples:

- Shoe: $\frac{L_S}{K_S} = 2 \left(\frac{w}{r} \right)^{-1}$ computer: $\frac{L_C}{K_C} = \frac{1}{2} \left(\frac{w}{r} \right)^{-1}$

Effect of trade on rental rate / w ratio:

- Equilibrium: $\frac{\bar{L}}{\bar{K}} = \frac{L_C}{K_C} \cdot \left(\frac{K_C}{\bar{K}} \right) + \frac{L_S}{K_S} \cdot \left(\frac{K_S}{\bar{K}} \right)$

Examples:

- Shoe: $\frac{L_S}{K_S} = 2 \left(\frac{w}{r} \right)^{-1}$ computer: $\frac{L_C}{K_C} = \frac{1}{2} \left(\frac{w}{r} \right)^{-1}$

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→ implies: $\frac{\bar{L}}{\bar{K}} = \frac{1}{2} \left(\frac{w}{r} \right)^{-1} \cdot \left(\frac{K_C}{\bar{K}} \right) + 2 \left(\frac{w}{r} \right)^{-1} \cdot \left(\frac{K_S}{\bar{K}} \right)$

Examples:

- Shoe: $\frac{L_S}{K_S} = 2 \left(\frac{w}{r} \right)^{-1}$ computer: $\frac{L_C}{K_C} = \frac{1}{2} \left(\frac{w}{r} \right)^{-1}$

Effect of trade on rental rate / w ratio:

- Equilibrium: $\frac{\bar{L}}{\bar{K}} = \frac{L_C}{K_C} \cdot \left(\frac{K_C}{\bar{K}} \right) + \frac{L_S}{K_S} \cdot \left(\frac{K_S}{\bar{K}} \right)$

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→ And thus: $\frac{w}{r} = \frac{\bar{K}}{\bar{L}} \cdot \left(\frac{1}{2} \frac{K_C}{\bar{K}} + 2 \frac{K_S}{\bar{K}} \right)$

Examples:

- Shoe: $\frac{L_S}{K_S} = 2 \left(\frac{w}{r} \right)^{-1}$ computer: $\frac{L_C}{K_C} = \frac{1}{2} \left(\frac{w}{r} \right)^{-1}$

Effect of trade on rental rate / w ratio:

- Equilibrium: $\frac{\bar{L}}{\bar{K}} = \frac{L_C}{K_C} \cdot \left(\frac{K_C}{\bar{K}} \right) + \frac{L_S}{K_S} \cdot \left(\frac{K_S}{\bar{K}} \right)$

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→ And thus: $\frac{w}{r} = \frac{\bar{K}}{\bar{L}} \cdot \left(\frac{1}{2} \frac{K_C}{\bar{K}} + 2 \frac{K_S}{\bar{K}} \right)$

$\frac{w}{r}$ decreases as K_C increases and K_S decreases

3- Effect of trade on factor prices

Clicker question

Assume that computers are more capital intensive than shoes. If the price of shoes increases with trade:

- a) Capital owners gain relatively more than workers
- b) Workers gain relatively more than capital owners

3- Effect of trade on factor prices

Clicker question

Assume that computers are more capital intensive than shoes. If the price of shoes increases with trade:

b) Workers gain relatively more than capital owners

Because in that case: W/R increases!

3- Effect of trade on factor prices

What's next?

- We have yet to examine whether workers actually gain or lose from trade.
- As for the Specific-Factor Model, we examine how MPK and MPL evolve.
- As for the Specific-Factor Model, this depends crucially on how L_C/K_C and L_S/K_S change in each industry.

3- Effect of trade on factor prices

Clicker question

Assume that computers are more capital intensive than shoes. If the price of computers increases with trade:

- a) Labor intensity increases in the Shoe industry and decreases in the Computer industry
- b) Labor intensity decreases in the Shoe industry and increases in the Computer industry
- c) Labor intensity increases in both industries
- d) Labor intensity decreases in both industries

3- Effect of trade on factor prices

Answer:

3- Effect of trade on factor prices

Answer:

Assume that computers are more capital intensive than shoes. If the price of computers increases with trade:

c) Labor intensity increases in both industries

Since the relative price of capital R/W increases, firms in ALL industries try to hire more workers relative to capital.

3- Effect of trade on factor prices

Answer:

Assume that computers are more capital intensive than shoes. If the price of computers increases with trade:

c) Labor intensity increases in both industries

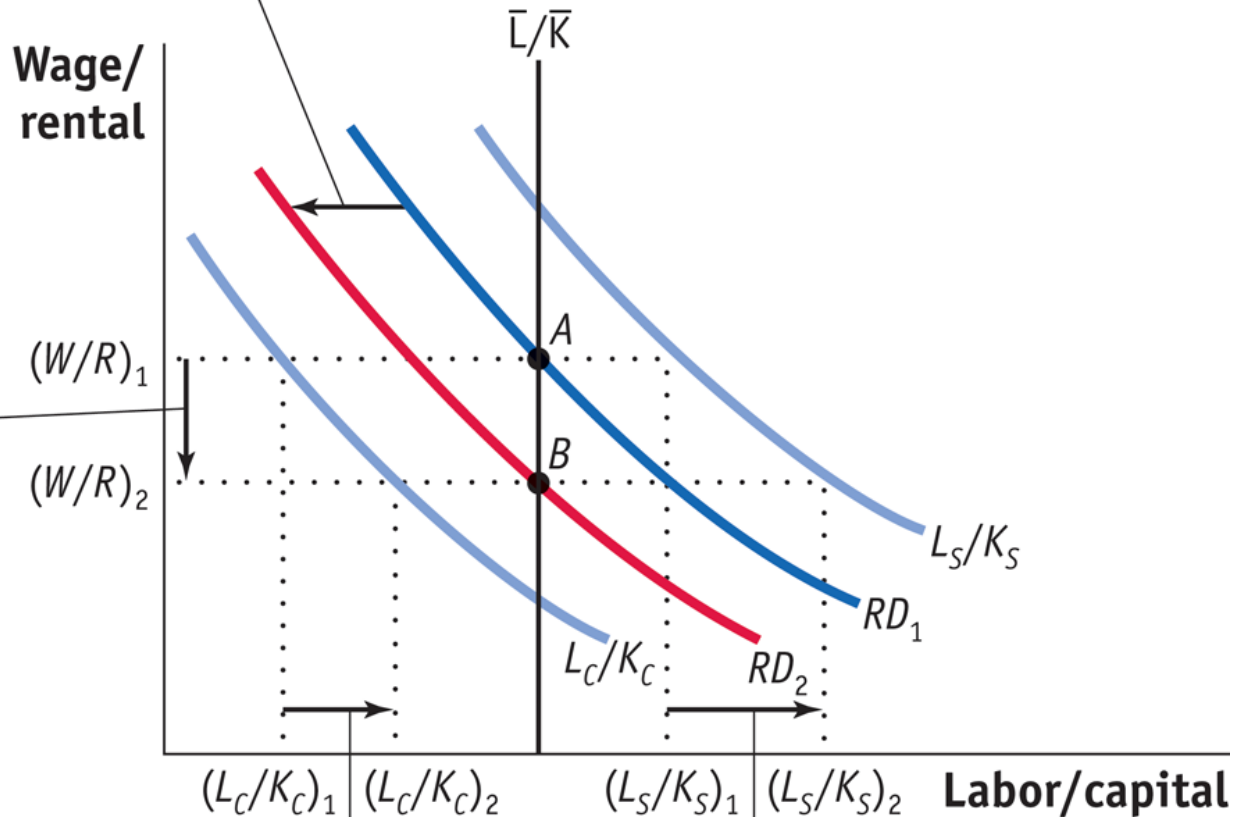
Since the relative price of capital R/W increases, firms in ALL industries try to hire more workers relative to capital.

On the graph:

- Moving to the right for the demand curve in each industry (light-blue curves).
- Notice that the curves specific to each industry do not move, it's just a movement along these curves.

1. An increase in the relative price of computers shifts the relative demand curve from RD_1 to RD_2 .

2. The relative wage decreases from $(W/R)_1$ to $(W/R)_2$.



3. At the new relative wage, the labor/capital ratio in each industry increases.

3- Effect of trade on factor prices

Effect of trade

At Home, opening to trade induces:

- An increase in the relative price of computers
- An expansion of the computer industry
- A decrease of the demand for labor
- A decrease in the wage/rental-rate ratio
- increase in labor intensity L_C/K_C and L_S/K_S in each industry

3- Effect of trade on factor prices

Effect of trade

$$\underbrace{\frac{\bar{L}}{\bar{K}} = \frac{L_C + L_S}{\bar{K}}}_{\text{Relative supply: No change}} = \frac{L_C}{K_C} \cdot \left(\frac{K_C}{\bar{K}} \right) + \frac{L_S}{K_S} \left(\frac{K_S}{\bar{K}} \right)$$

$\uparrow \quad \uparrow \quad \uparrow \quad \downarrow$

$\underbrace{\hspace{15em}}_{\text{Relative demand No change in total}}$

- Shift of K towards computers implies a increase in labor intensity in each industry
- On aggregate, the relative demand remains unchanged

3- Effect of trade on factor prices

Effect of trade on MPK and MPL?

3- Effect of trade on factor prices

Effect of trade on MPK and MPL?

$MPK_C \uparrow$ because L_C/K_C increases
(there are more workers to operate machines in the computer industry)

$MPK_S \uparrow$ because L_S/K_S increases
(there are also more workers to operate machines in the shoe industry)

Conversely, MPL decreases in both industries

3- Effect of trade on factor prices

We answered:

- What is the effect of trade on the wage/rental rate ratio?

Now:

- What is the effect of trade on the rental rate?
(in real terms, i.e. in terms of welfare)
- What is the effect of trade on wages?
(in real terms, i.e. in terms of welfare)

3- Effect of trade on factor prices

Effect on rental rate?

What about the rental rate? Welfare of K owners?

$$R = P_C \cdot MPK_C \quad \text{and} \quad R = P_S \cdot MPK_S$$

3- Effect of trade on factor prices

Effect on rental rate?

What about the rental rate? Welfare of K owners?

$$R = P_C \cdot MPK_C \quad \text{and} \quad R = P_S \cdot MPK_S$$

Real rate (compared to each price):

$$R/P_C = MPK_C \uparrow \text{ because } L_C/K_C \text{ increases}$$

(there are more workers to operate machines in the computer industry)

3- Effect of trade on factor prices

Effect on rental rate?

What about the rental rate? Welfare of K owners?

$$R = P_C \cdot MPK_C \quad \text{and} \quad R = P_S \cdot MPK_S$$

Real rate (compared to each price):

$$R/P_C = MPK_C \uparrow \quad \text{because } L_C/K_C \text{ increases}$$

$$R/P_S = MPK_S \uparrow \quad \text{because } L_S/K_S \text{ increases}$$

(there are also more workers to operate machines in the shoe industry)

3- Effect of trade on factor prices

Effect on rental rate?

What about the rental rate? Welfare of K owners?

$$R = P_C \cdot MPK_C \quad \text{and} \quad R = P_S \cdot MPK_S$$

Real rate (compared to each price):

$$R/P_C = MPK_C \uparrow \quad \text{because } L_C/K_C \text{ increases}$$

$$R/P_S = MPK_S \uparrow \quad \text{because } L_S/K_S \text{ increases}$$

→ The rental rate increases faster than any price in the Home country

3- Effect of trade on factor prices

Effect on wages?

What about wages? Welfare of workers?

$$W = P_C \cdot MPL_C \quad \text{and} \quad W = P_S \cdot MPL_S$$

“Real” wage (compared to each price):

$$W/P_C = MPL_C \downarrow \quad \text{because } L_C/K_C \text{ increases}$$

$$W/P_S = MPL_S \downarrow \quad \text{because } L_S/K_S \text{ increases}$$

→ Wages decreases faster than any price in the Home country

3- Effect of trade on factor prices

Determination of the Real Wage and Real Rental

Stolper-Samuelson Theorem:

If the Home country opens to trade, the price of computers increases (compared to the price of shoes)

and:

$$\frac{\Delta W}{W} < \frac{\Delta P_S}{P_S} < \frac{\Delta P_M}{P_M} < \frac{\Delta R}{R}$$

3- Effect of trade on factor prices

Determination of the Real Wage and Real Rental

Stolper-Samuelson Theorem:

In the long run, when all factors are mobile, an increase in the relative price of a good will increase the real earnings of the factor used intensively in the production of that good and decrease the real earnings of the other factor.

*PS: regardless of which industry employs this factor
(HO model is about the long-run: factors are mobile)*

3- Effect of trade on factor prices

Answer to initial clicker question for HO:

Assume that computers are more capital intensive than shoes. If the price of computers increases with trade:

c) Capital owners gain from trade and **workers lose**

Heckscher-Ohlin: Summary from Chapter 4

- We can generate trade by differences in endowments, even if technologies are the same
- **Heckscher-Ohlin Theorem**: if a country is abundant in a factor, it should exports in industries that are relatively intensive in this factor.
- The data support HO theorem only when also incorporate differences in productivity.
- **Stolper-Samuelson theorem**: An increase in the price of a good generates an increase in the real earning of the factor used intensively in the production of that good, and should decrease the real earning of the other factor

4- Trade and wage inequality

- Next parts:
 - A few words on wage inequality
 - FDI and migration (chapter 5)