

International Trade Problem Set #3

Heckscher-Ohlin Model

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SHORT REVISION

Heckscher Ohlin Model

A short revision of the model:

- ▶ In the Ricardian model there was only one input factor: labour
- ▶ H-O model we require two input factors: labour (L) and capital (K)
- ▶ Different goods may require different intensities of either input good.
- ▶ In this example we produce food and clothing. Food is more labour intense and thus requires relatively more labour. Clothing is more capital intense and requires relatively more capital.
- ▶ Denote Q_C and Q_F for the quantities produced of clothing and food respectively.
- ▶ Input factors are denoted with a subscript to indicate in what sector it is being used (K_C, K_F, L_C, L_F).
- ▶ We are studying a special case of the H-O model, with rigid technology. This results in a Leontief production function, where the input factor required of both goods remains fixed.
- ▶ Unlike in the Ricardian model the technology is equal across countries. Comparative advantage is not a result of different technology but rather due to a different endowment of input factors.

EXERCISE 1

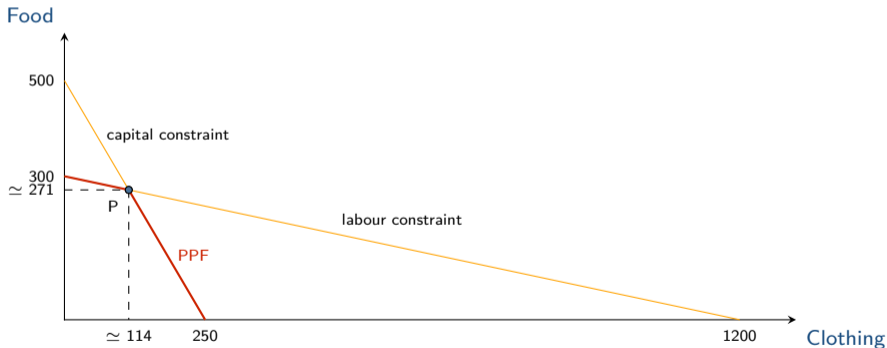
Setup

- ▶ Two goods: food and clothing
- ▶ Two inputs: labour and capital
- ▶ input requirements:
 - Food: $\alpha_{LF} = 4, \alpha_{KF} = 1$
 - Clothing: $\alpha_{LC} = 1, \alpha_{KC} = 2$
- ▶ endowment: $L = 1200, K = 500$

- a) Which good is relatively more labour intense or more capital intense respectively?
- ▶ To answer this question look at the production functions of each good:
 - ▶ $Q_F(L_F, K_F) = \min \left\{ \frac{1}{4}L_F, K_F \right\}$
 - ▶ $Q_C(L_C, K_C) = \min \left\{ L_C, \frac{1}{2}K_C \right\}$
- ⇒ Food is relatively more labour intense, clothing is more capital intense.

EXERCISE 1

- b) Draw the PPF of this country (clothing on the x-axis and food on the y-axis). At which point are both factors fully employed?
- ▶ To find the graph, look at the two constraints given by the total stock of the input factors:

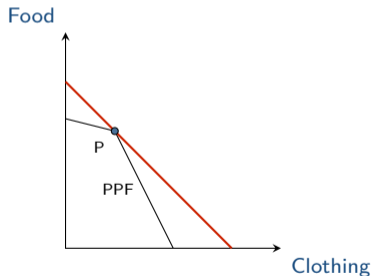


EXERCISE 1

- c) Can you say something about autarky prices in this country?
- ▶ To know something about the autarky prices we would have to look at the preferences of the representative consumer.
 - ▶ However, for an interior solution (i.e. $F > 0, C > 0$) it must be that $MRT = \frac{P_C}{P_F}$. This implies: $\frac{1}{4} \leq \frac{P_C}{P_F} \leq 2$.

EXERCISE 1

- d) Suppose autarky prices are given by $P_C = 5\$$, $P_F = 5\$$. At which point on the PPF does the country produce? Compute the wage rate and the capital rental rate under autarky.
- ▶ To find the production point, draw the price ratio.
 - ▶ To find the wage and rental rate note that perfect competition implies that marginal costs must be equal to marginal benefit:

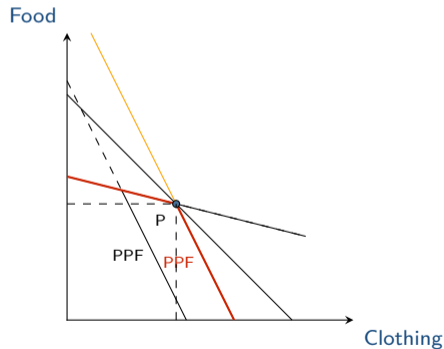


EXERCISE 1

- d) Suppose autarky prices are given by $P_C = 5\$$, $P_F = 5\$$. At which point on the PPF does the country produce? Compute the wage rate and the capital rental rate under autarky.
- ▶ To find the production point, draw the price ratio.
 - ▶ To find the wage and rental rate note that perfect competition implies that marginal costs must be equal to marginal benefit:
 - ▶ Food: $P_F = \alpha_{LF} \cdot w + \alpha_{KF} \cdot r$
 - ▶ Clothing: $P_C = \alpha_{LC} \cdot w + \alpha_{KC} \cdot r$
 $\Rightarrow w = \frac{1}{3}r$
 - ▶ in this specific case: $w = \frac{5}{7}, r = \frac{15}{7}$

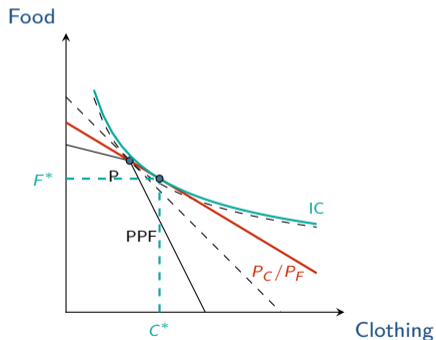
EXERCISE 1

- e) Starting from d), what happens to autarky production if the stock of capital increases. Which theorem did you confirm?
- ▶ After an increase of the capital stock, we produce more of the capital intensive good (Rybczynski-Theorem)



EXERCISE 1

- f) Now suppose the country opens up to trade. The foreign countries have generally higher ratios of $\frac{K}{L}$, i.e. they are relatively capital abundant. World price is given by $\frac{P_C}{P_F} = \frac{3}{5}$. Show graphically production and consumption of the economy under free trade.



EXERCISE 1

- g) Compute the wage rate and the capital rental rate under free trade and compare them to the autarky wage and capital rent rate. Which theorem did you confirm with this calculation?
- ▶ To find the wage and rental rate note that perfect competition implies that marginal costs must be equal to marginal benefit:
 - ▶ Food: $P_F = \alpha_{LF} \cdot w + \alpha_{KF} \cdot r$
 - ▶ Clothing: $P_C = \alpha_{LC} \cdot w + \alpha_{KC} \cdot r$
 $\Rightarrow w = r$
 - ▶ in this specific case: $w = 1, r = 1$
 - ▶ Under autarky the prices were given by $w = \frac{5}{7}, r = \frac{15}{7}$. Thus, opening up to trade has increased the real return of labour. We have confirmed the *Stolper-Samuelson* theorem, according to which the real return of the factor (labour) is raised, if the price of the good that uses this factor intensively increases (P_F has increased).

EXERCISE 2

Setup

- ▶ Two goods: food and manufactures
- ▶ Two inputs: labour and capital
- ▶ input requirements:
 - Food: $\alpha_{LF} = 2, \alpha_{KF} = 1$
 - Clothing: $\alpha_{LM} = 1, \alpha_{KM} = 3$
- ▶ Two regions in the world: Europe and Africa
- ▶ Endowment:
 - Europe: $L^E = 400, K^E = 900$
 - Africa: $L^A = 800, K^A = 450$

- a) Which region is relatively **capital abundant** and which **labour abundant**? Which good is relatively **capital intensive** and which **labour intensive**

EXERCISE 2

Africa: $L^A = 800, K^A = 450$; **Europe:** $L^E = 400, K^E = 900$

Food: $\alpha_{LF} = 2, \alpha_{KF} = 1$; **Clothing:** $\alpha_{LM} = 1, \alpha_{KM} = 3$

a) Which region is relatively **capital abundant** and which **labour abundant**? Which good is relatively **capital intensive** and which **labour intensive**?

▶ Europe: $\frac{K^E}{L^E} = 2.25$

▶ Africa: $\frac{K^A}{L^A} = 0.5625$

⇒ Europe is relatively more capital abundant.

▶ Food: $\frac{\alpha_{KF}}{\alpha_{LF}} = 0.5$

▶ Manufactures: $\frac{\alpha_{KM}}{\alpha_{LM}} = 3$

⇒ Manufactures are relatively more capital intensive.

EXERCISE 2

b) Draw the PPFs for both regions (draw M on the X-axis and F on the Y-axis)?

Figure: Europe

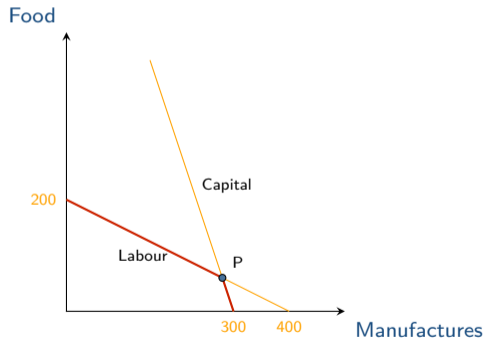
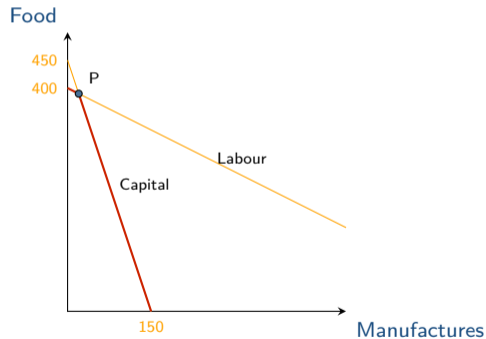


Figure: Africa



EXERCISE 2

- c) Suppose both regions have the same preferences, what do you think which region has the higher relative autarky price of food?
- ▶ Relative price of food is higher in Europe

Figure: Europe

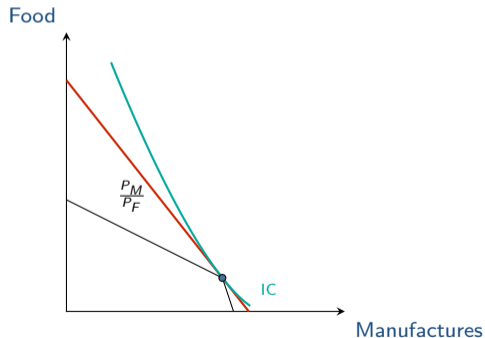
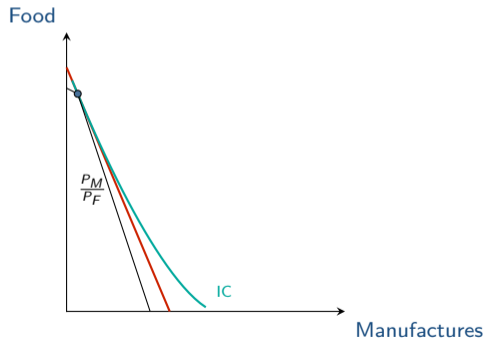


Figure: Africa



EXERCISE 2

- d) Suppose autarky prices of food and manufactured goods in Africa are given by $p_F = 1\$$ and $p_M = 2\$$ and in Europe by $p_F = 1\$$ and $p_M = 1\$$. If the regions open up to trade who will gain and who will lose from trade?
- ▶ Both regions gain from trade. In Africa workers gain. In Europe capital owners.

Figure: Europe

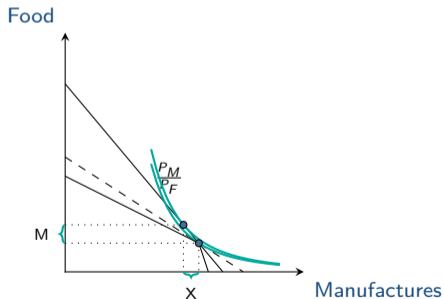
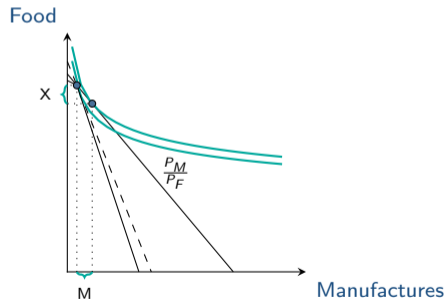


Figure: Africa



EXERCISE 2

- e) In which region are the (real) wages higher in autarky? In which country are (real) wages higher with trade?
- ▶ By the argument of marginal cost equal to marginal benefit we can compute the wage and rental rate:
 - ▶ Autarky Europe

$$P_M^E = 3r^E + w^E \Rightarrow 1\$ = 3r + w$$

$$P_F^E = r^E + 2w^E \Rightarrow 1\$ = 1r + 2w$$

$$\Rightarrow w^E = 2r^E; w^E = \frac{2}{5}, r^E = \frac{1}{5}$$
 - ▶ Autarky Africa

$$P_M^A = 3r^A + w^A \Rightarrow 2\$ = 3r + w$$

$$P_F^A = r^A + 2w^A \Rightarrow 1\$ = 1r + 2w$$

$$\Rightarrow w^A = \frac{1}{3}r^A; w^A = \frac{1}{5}, r^A = \frac{3}{5}$$
- \Rightarrow Real wages are higher in Europe under autarky: $\frac{w^E}{r^E} = 2 > \frac{w^A}{r^A} = \frac{1}{3}$

EXERCISE 2

e) In which country are the (real) wages higher in autarky? In which country are (real) wages higher with trade?

▶ By the argument of marginal cost equal to marginal benefit we can compute the wage and rental rate:

▶ Trade Europe

$$P_M^T = 3r^E + w^E$$

$$P_F^T = r^E + 2w^E$$

▶ Trade Africa

$$P_M^T = 3r^A + w^A$$

$$P_F^T = r^A + 2w^A$$

⇒ Under free trade the prices of the goods are equal and thus because the two regions have the same technology it must be that the real wages are also equal across the two regions.

EXERCISE 2

- f) At the moment trade in agricultural products is severely restricted by tariffs. Thinking loosely in the framework of the H-O model and the Stolper-Samuelson theorem, explain how liberalization of trade could decrease migration from Africa to Europe. (Keep in mind what assumptions are made in the H-O model and what additional assumptions are made in the exercise question. Are they plausible? Also keep in mind that in the H-O model there is no migration)
- ▶ Stolper-Samuelson theorem says that an increase of the relative price of good X, will increase the real return of the factor that is used intensively in the production of X, and lower the real return of the other input factor.
 - ▶ Therefore the liberalization of trade would lower the real wage of labour in Europe and increase the real wage of labour in Africa. \Rightarrow leads to migration from Europe to Africa.
 - ▶ We assumed food to be labour intensive, and equal technology in Europe and Africa