

# Exercise Sheet 3: The Heckscher-Ohlin Model

In the Ricardian model, production of goods requires only labor as production factor. In the Heckscher-Ohlin model, production of goods requires two production factors, labor and capital. All goods require both labor and capital as input factor. But different goods may require different input factors with different *intensity*, that is, one good may require relatively more capital and another good relatively more labor. Consider our usual example with two goods, clothing and food, and two input factors, labor and capital. In the H-O model, the production of both goods (food and clothing) requires both labor and capital. However, the production of clothing may require relatively more capital (or vice versa).

Denote  $Q_C$  and  $Q_F$  as production of clothing and food respectively. Labor used in the clothing sector and food sector respectively is denoted by  $L_C$  and  $L_F$ . Capital used in the clothing sector and food sector respectively is denoted by  $K_C$  and  $K_F$ .

The H-O model then postulates production functions for clothing and food of the form

$$Q_C = Q_C(L_C, K_C) \quad (1)$$

$$Q_F = Q_F(L_F, K_F) \quad (2)$$

In the exercises we will only study a special version of the H-O model which is also called the "rigid technology version" of the H-O model. In the rigid technology version of the H-O model, the input factors needed to produce a certain good are fixed. (These production functions are also called Leontief production functions). For instance, in order to produce one unit of clothing, you always need a fixed amount of capital and a fixed amount clothing. In more general versions of the H-O model, the inputs can be changed - you can produce one unit of clothing with different "mixes" of labor and capital.

Different to the Ricardian model it is assumed in the H-O model that all countries have the same technology. Comparative advantage is not a result of different technologies, but of different endowments with production factors.

### Exercise 1

Consider our usual setting with two goods (food and clothing) and two inputs (capital and labor). Units of labor and capital respectively needed to produce one unit of food are given by  $a_{LF} = 4, a_{KF} = 1$ , meaning that you need 4 units of labor and 1 unit of capital to produce 1 unit of food. The input requirements to produce one unit of clothing are given by  $a_{LC} = 1, a_{KC} = 2$ . Denote  $L_C$  and  $K_C$  as labor and capital used in the clothing sector and  $L_F$  and  $K_F$  as labor and capital used in the food sector.

- a) Which good is relatively labor intensive, which one relatively capital intensive?
- b) Suppose the total capital stock in the country is given by  $K = 500$  and the total labor force by  $L = 1200$ . This implies that  $K_F + K_C \leq 500$  and  $L_F + L_C \leq 1200$ . Draw the production possibility frontier (PPF) of the country (draw clothing on the X-axis and food on the Y-axis). At which point are both factors fully employed? (You do not need to calculate how many units of each good are produced, just show the production point graphically)
- c) Can you say something about autarky prices in this economy?
- 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.
- e) Starting from d), show what happens to autarky production if the stock of capital increases. Which theorem did you confirm? (it is enough to show it graphically)
- f) Now suppose the economy opens up to trade. The foreign countries have generally higher ratios of  $\frac{K}{L}$ , i.e. they are relatively capital abundant compared to the home economy. The relative world price of the capital intensive good (clothing) is lower than the autarky price in the home country. World prices are given by  $P_C = 3\$, P_F = 5\$$ . Show graphically production and consumption of the economy under free trade.
- g) Compute the wage rate and the capital rental rate under trade and compare them to the autarky wage and capital rental rate. Which theorem did you confirm with this calculation?

### Exercise 2

Consider again the rigid-technology version of the H-O model. Suppose there are two goods: Food (F) and manufactures (M) that both need capital (K) and labor (L) as input factors. Denote  $Q_F$  as the output of food and  $Q_M$  as the output of manufactures.  $K_F$  and  $L_F$  are the amounts of capital and labor respectively used in the food sector while  $K_M$  and  $L_M$  are the amount of capital and labor used in the manufactures sector. Units of capital and labor respectively needed to produce one unit of food are given by  $a_{KF} = 1$  and  $a_{LF} = 2$ . Units of capital and labor respectively needed to produce one unit of manufactures are given by  $a_{KM} = 3$  and  $a_{LM} = 1$ .

There are two countries in the world: "Europe" and "Africa". The two countries have the same preferences and the same technology. In Europe, total amounts of labor and capital respectively are given by  $L^E = 400$  and  $K^E = 900$ . In Africa, total amounts of labor and capital are given by  $L^A = 800$  and  $K^A = 450$ .

- a) Which country is relatively capital abundant, which country is relatively labor abundant? Which good is relatively capital intensive, which is relatively labor intensive?
- b) Draw the PPFs for both countries (draw M on the X-axis and F on the Y-axis).
- c) Given the assumption that both countries have the same preferences (indifference curves look the same) what do you think which country has the higher relative autarky price of food? (illustrate your answer graphically)
- d) Suppose autarky prices of food and manufactures respectively in Africa are given by  $p_F = 1\$$  and  $p_M = 2\$$ . In Europe autarky prices are given by  $p_F = 1\$$  and  $p_M = 1\$$ . If the two countries open up to trade who will gain from trade and who will lose?
- e) In which country are the (real) wages higher in autarky? In which country are (real) wages higher with trade?
- 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 in agricultural products could decrease

migration from Africa to Europe. (But 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 itself, migration is ruled out.)