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The Heckscher–Ohlin Model

Setup of the model: $2 \times 2 \times 2$

- 2 factors: skilled labor S and unskilled labor U
- 2 commodities/sectors: hightech H and lowtech L
  we asume that hightech is skilled-labor intensive and lowtech is unskilled-labor intensive (in the sense that at the same relative factor price one sector uses relatively more skilled labor than the other)
- 2 countries: home and foreign
  we assume that home is relatively skill abundant whereas foreign is unskilled-labor abundant, i.e. $S/U > S^*/U^*$
  that is, countries differ in their relative factor endowments whereas we abstract from differences in technology or preferences

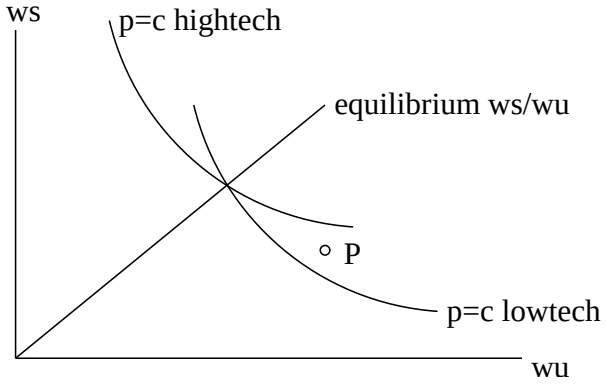
The four main results of the HO model — an overview:

	global	local
prices	FPE	Stolper–Samuelson
quantities	Heckscher–Ohlin	Rybczynski

The Stolper–Samuelson result in the Mussa diagram:

This result concerns the relationship between the relative price of final goods on the world market and the domestic relative factor price: *If the price of an output good rises relative to the other output good then the factor that is used intensively in the production of the former increases in price relative to the other factor.* We will derive this result in the so-called Mussa diagram. The Mussa diagram has factor prices on its axes. Let us put w_U (the wage or factor price of unskilled labor) on the horizontal and w_S (the wage of skilled labor) on the vertical axis.

Mussa diagram: zero profit lines



What we depict in this diagram are so-called zero profit lines. In case you wonder why we are interested in zero profits: these models assume constant returns to scale which implies constant marginal cost which in turn implies constant average or unit cost that must equal marginal cost. In equilibrium price better equals this unit cost because otherwise you want to produce an infinite amount (if $p > c$) or not at all (if $p < c$) and that cannot be an equilibrium.

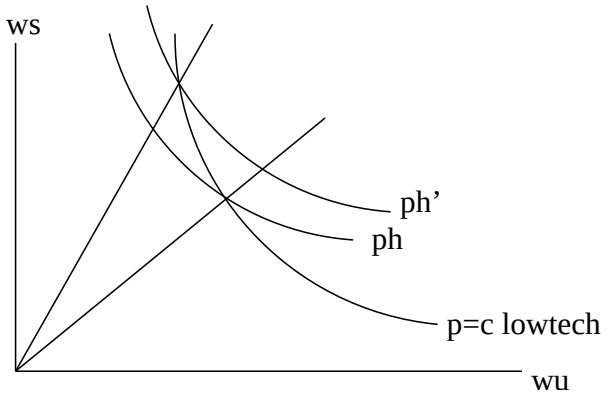
How do these zero profit lines look like. They must be negatively sloped because when one factor price goes up the other one should go down to keep total unit cost equal to price. Why do they have the convex shape as shown in the diagram? Recall from micro that the cost function is concave in prices (turned over salad bowl). So if they were straight lines cost would decrease as one moves northwest or southeast. But cost is supposed to stay equal to price so they have to bend the way they do to counteract this effect.

Let us find out what happens above and below these curves. Northeast both factor prices are higher so unit cost is higher than price and we are incurring losses. Southwest the opposite is true and the sector makes a profit.

Since in equilibrium both sectors make zero profits (see above) the ray through the origin and the intersection represents the equilibrium relative factor price. We still have not determined which curve represents which sector, though. In order to see that, consider the point P which stand for relatively cheaper skilled and more expensive unskilled labor than in equilibrium. We see that at P one sector makes a loss (because P lies northeast of its curve) and this must be the unskilled-labor intensive lowtech sector. The hightech industry on the other hand makes a profit and its curve passes northeast of P.

After having explained the diagram, let us now use it to derive a relationship between the relative output price P_H/P_L and the relative factor price, w_S/w_U. This is important because the relative output price is determined on the world market and we would like to know how it affects our domestic relative factor price once the country opens up to trade.

Suppose P_H/P_L rises and for concreteness let us assume it rises because P_H increases whereas P_L remains unchanged. Then the zero profit line of the hightech sector must shift out because its price has risen, and for unit cost to match that higher price both factor prices must be higher.



Now see what happens to the relative factor price. The ray through the intersection shifts counter clockwise implying that skilled labor is becoming more expensive. More generally, we see that a price rise (decrease) in the skilled labor intensive sector raises (lowers) the price of that factor (that is, the factor this sector uses intensively). The same holds for the other sector and unskilled labor, just draw the appropriate diagram. This is the Stolper–Samuelson result.

But we can say more. We see that the price of skilled labor increases more than proportionally. Eg if the output price increases by 10% then the wage of skilled labor goes up by more than 10%. To see this take a look at the old equilibrium ray. If the wage of skilled labor increased proportionally then it would increase to the point where the old ray intersects the new zero profit line. But we see that it goes up even more because the ray turns so it must increase more than proportionally.

This is the so-called magnification effect:

$$\hat{w_S} > \hat{p_H} > \hat{p_L} > \hat{w_U}$$

or — depending on which way the relative output price change goes

$$\hat{w_S} < \hat{p_H} < \hat{p_L} < \hat{w_U}$$

(where the hats stand for percentage changes of a variable)

These inequalities tell us something interesting about the distributional implications of trade (opening up to trade changes the relative output price): the owners of the losing factor must be worse off no matter what combination of output goods they consume because the price of their factor falls by more than the price of either output good. The opposite is true for the lucky factor: its owners are unambiguously better off. This result has been very influential and still forms the basis for the public discussion of the distributional effects of trade. It seems to explain the increase in inequality in developed countries (lowtech goods have become relatively cheaper, therefore the wage for unskilled labor has declined in relative terms). But it implies the opposite for the country we trade with. Yet, there is hardly any evidence of decreasing inequality in developing countries.

Factor Price Equalization:

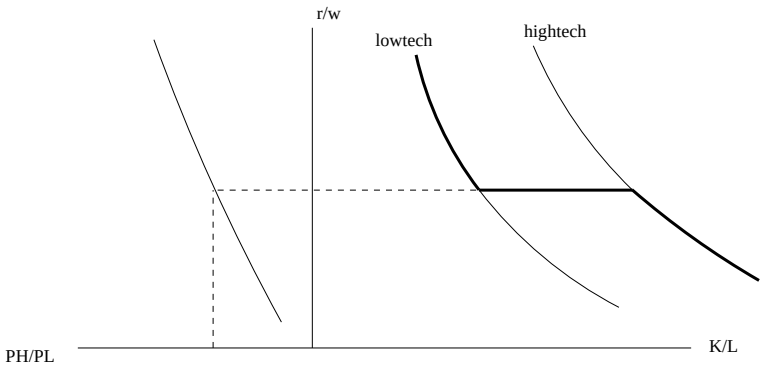
The factor price equalization result tells us that *free trade equalizes factor prices in both countries.* The argument goes as follows: with free trade the law of one price implies equal output prices in both countries. Then the Stolper–Samuelson result establishes a link between relative output and relative factor price (see left part of diagram below). Its derivation depended only on technology and since technologies are assumed to be the same in both countries the link must be the same. So the relative factor price is also equal. But with equal output prices and equal relative factor price absolute factor prices have to be equalized because otherwise sectors could not make zero profits everywhere.

This results depends crucially on the rather unrealistic assumption of equal technologies in both countries. So it is not surprising that there is little evidence for FPE in the real world. But even if we take the theoretical result at face value it breaks down as soon as one country becomes completely specialized. Look at the right half of the diagram below. If a country's relative factor endowment lies between the intersections of the relative factor price line with the sectoral factor intensities then the country produces a combination of both commodities. But if the relative factor endowment lies too far left or too far right then it completely specializes and FPE breaks down. It stops producing one commodity and, referring back to the Mussa diagram (which established the link between output and factor prices), we no longer need to be on that sector's zero profit line, in other words the relative factor price must no longer be the intersection. In the diagram below the relative factor price follows the lowtech factor intensity line up for very labor abundant countries and falls with hightech's factor intensity for very capital abundant countries.

The Heckscher–Ohlin result:

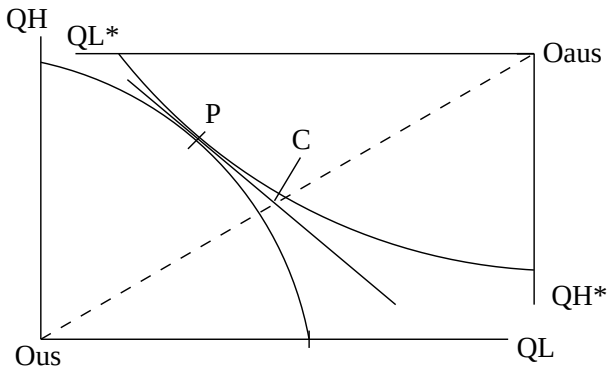
This is the main result of the Heckscher–Ohlin model. It explains the pattern of trade, i.e. which country exports which commodity: *a country exports that commodity which is produced using the factor intensively with which the country is relatively well endowed.* There are (at least) three ways to illustrate this result:

Consider the right hand side of the diagram below. If two countries have different relative factor endowments but equal consumption patterns as the Heckscher–Ohlin model presumes then the factor intensity of that consumption pattern (equal for both countries) must lie between the capital labor ratios of both countries. This implies that one country produces a more capital intensive output combination than it consumes. But this can only be the case if it exports the capital intensive good and vice versa for the other country establishing the pattern predicted by the HO theorem.

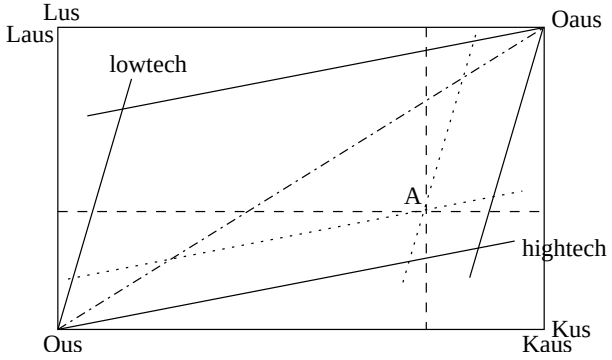


The second way of illustrating the HO result relies on the PPFs. Note that the production possibility sets are convex for neoclassical production technology. Furthermore, the capital abundant home country can produce relatively more hightech while foreign's PPF stretches out horizontally. Now suppose foreign is Australia and turn their PPF upside down. They both trade at one world market equilibrium relative price and their

respective production points are the tangency points of that price line with their respective PPFs. The diagram below moves these two production points so that they coincide in point P. Now remember that both have the same consumption pattern implying that consumption lies on the diagonal connecting the two origins (to see this consider any point off the diagonal and note that home and foreign then consume different ratios of hightech relative to lowtech). Again we see that home must export hightech and foreign lowtech in line with the HO result because home produces more hightech than it consumes and vice versa down under.



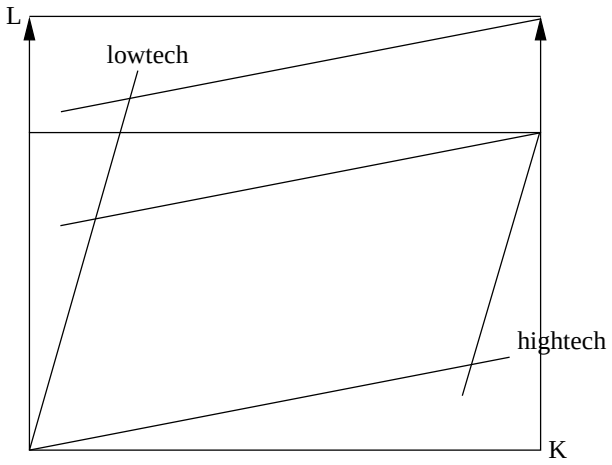
The third way uses a factor quantities Edgeworth box for the whole world. We start with a world market free trade equilibrium. This equilibrium involves a certain relative output price and via FPE one relative factor price. This relative factor price implies particular factor intensities in each of the two sectors (cf. first diagram). These intensities are represented by the rays in the diagram below. Now suppose the world is divided as implied by point A. The rectangle to the southwest of A is the home country's factor endowments box and the rectangle northeast of A is foreign's. A should better lie off the diagonal because the HO model assumes different relative factor endowments. But again equal consumption patterns imply that the consumption point lies on the diagonal. More precisely it lies on the diagonal somewhere in between the two national rectangles because otherwise one country would be handing out presents in the form of factor endowments. Again we see that home's production contains more capital relative to labor than its consumption so it must be exporting the capital intensive commodity.



The HO model used to be THE model of international trade and its predictions for trade patterns have been tested extensively. The results were disappointing at first (Leontief's result is known as the Leontief paradox). They have improved somewhat over the years as researchers adapted the original model to better fit the data. It does a decent job at explaining north-south trade but performs much worse when it comes to the far larger trade flows between developed countries.

Rybczynski:

This result is the mirror image of Stolper–Samuelson: instead of establishing a link between relative output price and relative factor price it seeks to establish such a link between factor quantities (ie endowments) and output quantities. Take the diagram above and cut out one national rectangle. Now suppose the country's endowment with labor increases, ie the box increases in height, and assume this does not change the relative factor price and the factor intensities it implies. Then we see that the output of the labor intensive lowtech sector increases and the output of hightech decreases. Looking closer, we can see that the increase in output of lowtech is overproportional.



So we obtain a magnification effect in quantities:

$$\hat{Q_L} > \hat{L} > \hat{K} > \hat{Q_H}$$

or — depending on which way the factor quantity change goes

$$\hat{Q_L} < \hat{L} < \hat{K} < \hat{Q_H}$$