Econ 165 Stanford University
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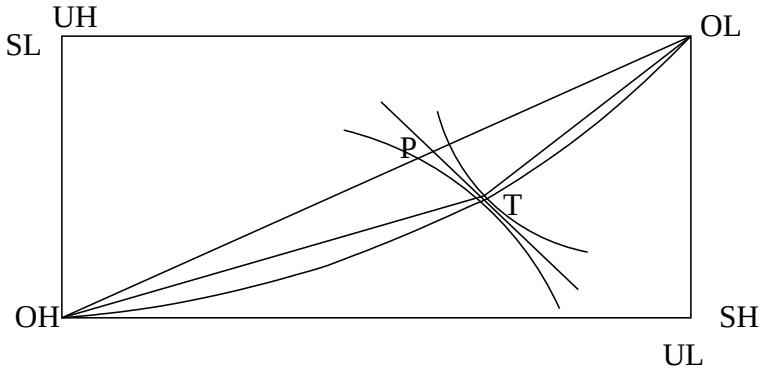
Notes on Heckscher–Ohlin

Deriving the PPF of the HO model

setting the stage:

- the 2 factors are skilled labor S and unskilled labor U
- the 2 commodities are hightech H and lowtech L
- 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)
- one country, say home, is relatively skilled labor abundant while foreign is unskilled labor abundant, i.e. $S/U > S^*/U^*$.

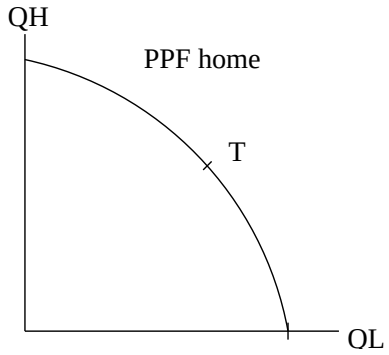
Let's take a look at the efficient factor allocations accross the two sectors in a given country using a graphical device called the (production) Edgeworth box. The size of this box is determind by the home country's endowments with U and S.



Recall the concept of a contract curve. It's the set of points that do not leave any possiblity of producing more of both goods. In the diagram, it's the set of points where the isoquants of the lowtech and hightech sectors are tangent.

Let us show that this line lies below the diagonal. To see this consider the point P. If the isoquants were tangent at P then at this relative factor price both sectors would have the same factor intensities. But we assumed that hightech is skill intensive while low tech is unskilled labor intensive. It follows that the tangency point T must lie below the diagonal. Making this argument up and down the diagonal shows that the contract curve lies below the diagonal.

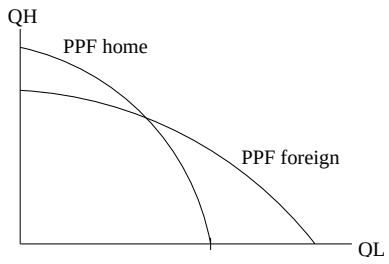
Now translate the contract curve into output space in order to obtain the PPF. So we wander up and down the contract curve and put every single point into the diagram below. Why does the PPF have the shape the diagram shows? In other words, why is the PPF concave and the set of possible production points convex?



Starting from point T on the contract curve, let us wander northeast which implies increasing production of hightech and producing less lowtech. Look at the line connecting T and the origins. As we wander northeast, the line connecting to hightech's origin becomes steeper implying that relatively more unskilled labor has to be used in the hightech sector. But hightech is the skill intensive sector so this reduces productivity. The opposite holds true for lowtech. Relatively more unskilled labor is used and since this is the unskilled labor intensive sector this increases productivity.

Translate this argument into the second diagram. Start at the horizontal intercept which corresponds to hightech's origin in the Edgeworth box: only lowtech is produced. As me move northeast on the contract curve hightech's productivity decreases while lowtech's increases. This is why the PPF has that particular shape. As we move northwest on the PPF we have to give up more and more lowtech to get a unit of hightech reflecting the changes in productivity.

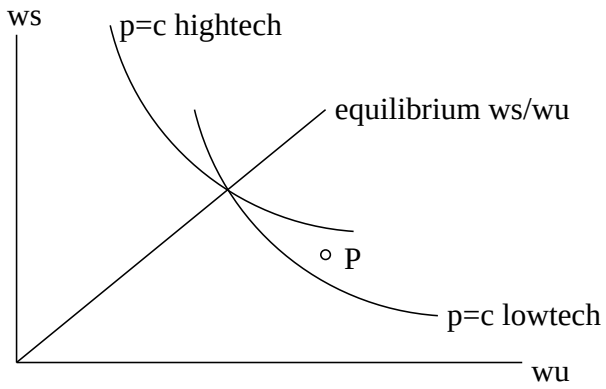
Consider the second country. Foreign is relatively unskilled labor abundant so its Edgewortbox is relatively higher/narrower than home's. This implies that in its northeast corner the hightech sector produces with relatively more unskilled labor than at home and is therefore less productive. The lowtech sector also produces with relatively more unskilled labor in the southwest corner than at home but that makes it more productive. So foreign's PPF has a relatively lower vertical intercept and a more eastern horizontal one as depicted in the third diagram.



Deriving the Stolper–Samuelson result in the Mussa diagram

The Mussa diagram has factor prices on its axes. Let's 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. As before, suppose hightech is skill intensive and lowtech unskilled labor intensive.

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.

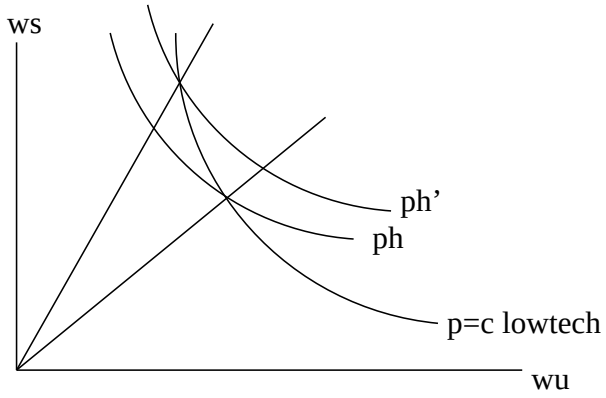
Let's try and see what happens above and below these curves. Northeast both factor prices are higher so unit cost is higher than price and we are incurring losses. Southwest the opposite is true and the sector makes a profit.

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 need to determine 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's now use it to derive a relationship between the relative output price P_H/P_L and relative factor price the 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.

Suppose P_H/P_L rises and for concreteness let us assume it rises because P_H increases while 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

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

(the hats stand for percentage change in that particular variable)