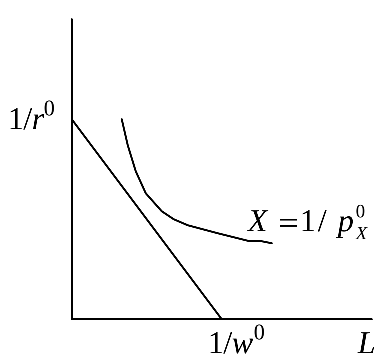
Problem Set 2 - *Answers*

The Heckscher-Ohlin Model

1. Which of the following characterize the Heckscher-Ohlin Model?
   a. Perfect mobility of factors across industries *Yes*
   b. Perfect mobility of factors across countries *No*
   c. Constant returns to scale *Yes*
   d. The law of diminishing returns *Yes*
   e. Identical technologies across industries *No*
   f. Identical technologies across countries *Yes*
   g. Monopolistic competition *No*
   h. Perfect competition *Yes*
   i. Full employment *Yes*
   j. Balanced trade *Yes*
   k. Factor intensity reversals *No (These are assumed not to occur.)*
   l. Identical homothetic preferences *Yes (This is not a necessary assumption for all results of the model, but it is an assumption that we will routinely use.)*

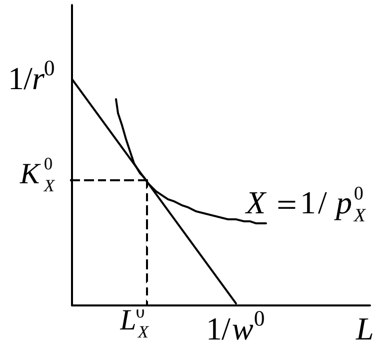
2. Suppose that the price of a good, *X*, is p_X^0 and that potential producers of that good in a country face factor prices w^0 and r^0. The three figures below show three ways that these prices might appear in an isoquant-isocost diagram. What can you say, in each case, about what will happen in the *X* industry in this country? That is, will the good be produced, can these prices constitute an equilibrium, and if so, what technique of production will be used to produce *X*?

a)



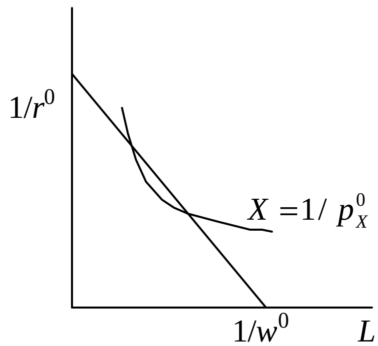
This says that a dollar's worth of X requires more factors than can be bought with one dollar. Therefore good X will not be produced at these prices.

b)



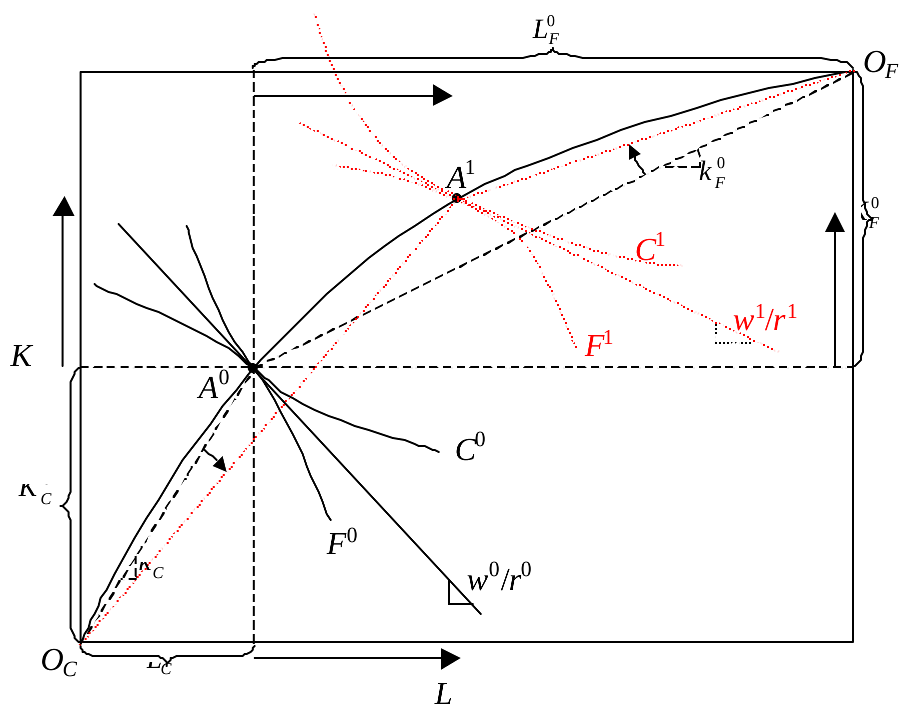
Here producers of X exactly break even, spending one dollar on factors that will produce one dollar's worth of X, if they use the least-cost technique of producing it. That least-cost technique is the tangency between the unit isocost line and the unit-value isoquant, and it therefore uses L_X^0 and K_X^0 to produce one dollar's worth of X. (Unless $p_X^0 = 1$, this is not one unit of X itself, so these are not the unit factor requirements a_{LX} and a_{KX}. We cannot determine these from the information given.)

c)



Here, all of the points on the isoquant inside the isocost line are ways to produce a dollar's worth of X at a cost of less than one dollar, thus making a profit. This situation will attract entry into the industry, seeking this profit, and will continue to do so until either the factor prices change (at least one of them rising due to the increased demand for factors) or the price of X falls (due to the increased supply of X). This cannot be an equilibrium situation.

3. The Edgeworth Box below shows the contract curve of a country as well as a particular allocation, A^0, along that contract curve at which the country would produce, given certain prices, p_C^0 and p_F^0. Its outputs at A^0 are C^0 and F^0.



a. What is the wage-rental ratio, w^0/r^0, in this initial equilibrium? Are you able to determine the factor prices, w^0 and r^0, individually? *The ratio is shown by the slope of the straight line tangent to both isoquants at A^0. We cannot determine w^0 and r^0, individually.*

b. Identify in the figure the allocations of labor and capital to each of the industries, K_C^0, L_C^0 K_F^0, and L_F^0, as well as their ratios, $k_C^0 = K_C^0 / L_C^0$ and $k_F^0 = K_F^0 / L_F^0$. *See figure above.*

c. Now consider the different allocation, also along the contract curve, shown as A^1. In order for the country to produce there, how would prices have to differ from p_C^0 and p_F^0? *The relative price of cloth must rise in order for the economy to move from A^0 to A^1. That is, $p_C^1 / p_F^1 > p_C^0 / p_F^0$.*

d. How do the factor allocations you looked at in part (b), and their ratios, differ at A^1 from what they were at A^0? *These are shown by the arrows in the figure above, from which we see that $K_C^1 > K_C^0$, $L_C^1 > L_C^0$, $K_F^1 < K_F^0$, $L_F^1 < L_F^0$, $k_C^1 < k_C^0$, $k_F^1 < k_F^0$.*

e. Using the full employment conditions for the two factors, show that the capital-labor ratio of the country as a whole, $k=K/L$, is a weighted average of the ratios in the two sectors, k_C and k_F.
The full employment conditions are $L_C + L_F = L$, $K_C + K_F = K$.
From the first, $L_F = L - L_C$. Therefore

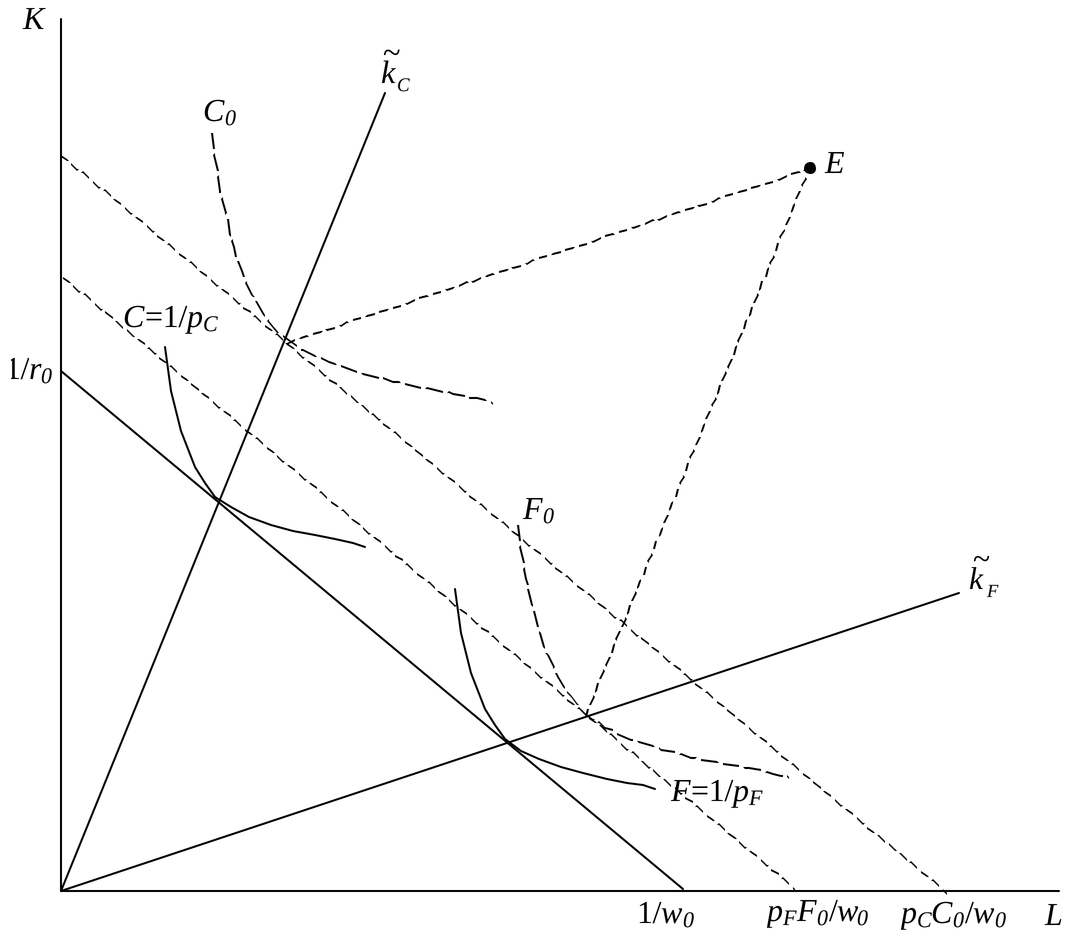
$$k = \frac{K}{L} = \frac{K_C + K_F}{L} = \frac{K_C}{L} + \frac{K_F}{L} = \frac{K_C}{L_C}\frac{L_C}{L} + \frac{K_F}{L_F}\frac{L_F}{L} = k_C\frac{L_C}{L} + k_F\frac{1 - L_C}{L}$$

which is a weighted average.

f. In part (d), you should have found that both ratios, k_C and k_F, fell in going from A^0 to A^1. Does this mean, in view of the result in part (e), that k has fallen also? Why or why not? *The ratio k has <u>not</u> fallen, since it is just the ratio of the factor endowments, which are given. The reason that k_C and k_F were both able to fall without lowering k is that the weights, in the weighted average of part (e), have changed. By reallocating resources into the cloth sector, L_C/L rises, putting more weight on the larger of the two capital-labor ratios. This makes up for the fall in both of them.*

g. Draw isoquants for both industries through point A^1. Now identify the wage-rental ratio, w^1/r^1, as you did in part (a). How does it compare to w^0/r^0? *The wage-rental ratio must be smaller at A^1 than at A^0: $w^1/r^1 < w^0/r^0$. That is, the isoquants are flatter there than at A^0. The reason is that the capital-labor ratios have both fallen, so that the industries move along their isoquants toward less capital and more labor, and when that happens they get flatter, due to their curvature. I'd* *be willing to bet that most of you, at least when you first drew the new isoquants, drew them steeper.*

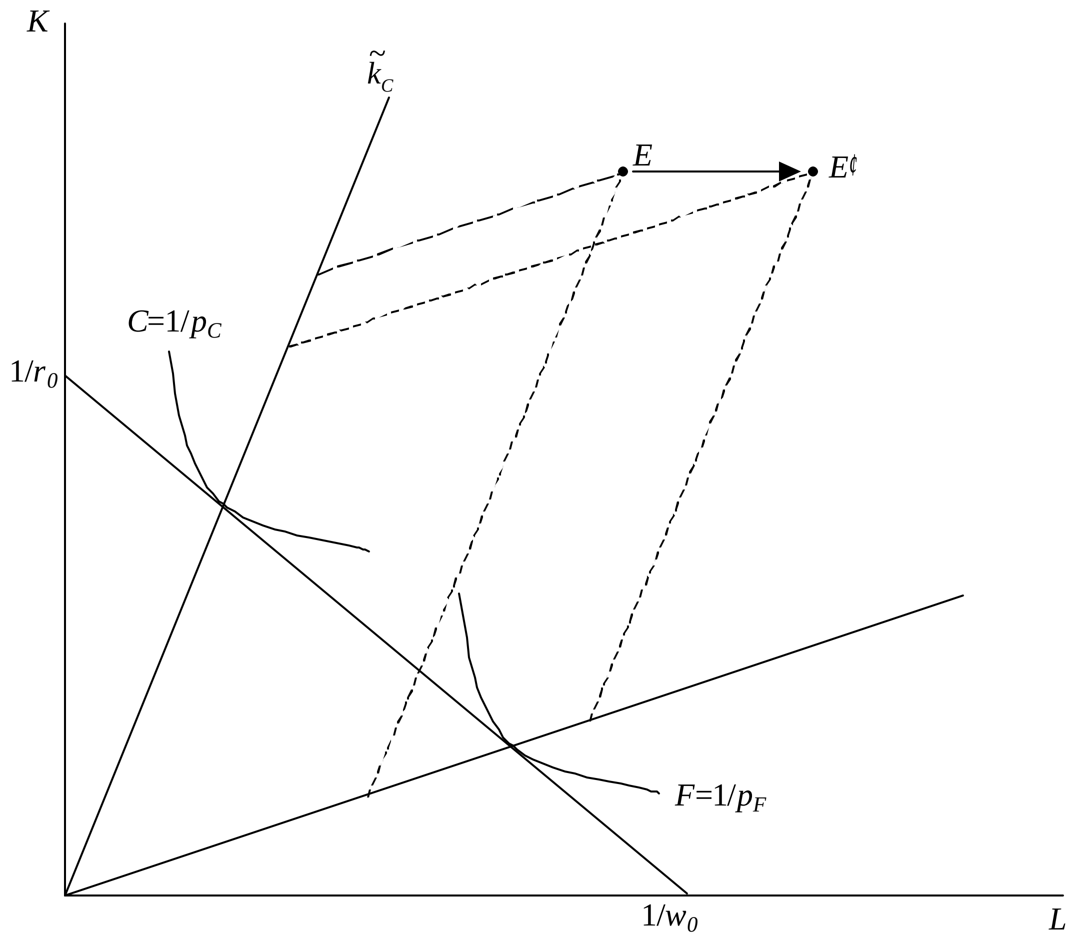
4. Starting from the unit-value isoquants shown below and using the factor endowments at point *E*, carefully construct the rest of the pieces of the Lerner diagram for this economy. Suppose that this country spends half of its income on Cloth and half on Food. What does it export and what does it import?



The construction of the Lerner Diagram determines the factor prices, w_0 and r_0, that are consistent with producing both goods, and it also determines the ratios of factors employed at those factor prices in both sectors and thus the diversification cone. Since E is in that cone, the country will in fact diversify. The parallelogram construction determines the two factor allocations and thus the isoquants representing the country's output, C_0 and F_0. The value of these outputs equals the value of their inputs (since profits are zero), and the two additional isocost lines drawn tangent to them therefore shows what they are worth, for example in units of labor by their intercepts with the labor axis. We see that the value of cloth produced is larger than the value of food produced, and thus that the country produces more than half of its income from cloth. Since is spends just half of its income on cloth, it must <u>*export cloth and import food*</u>*.*

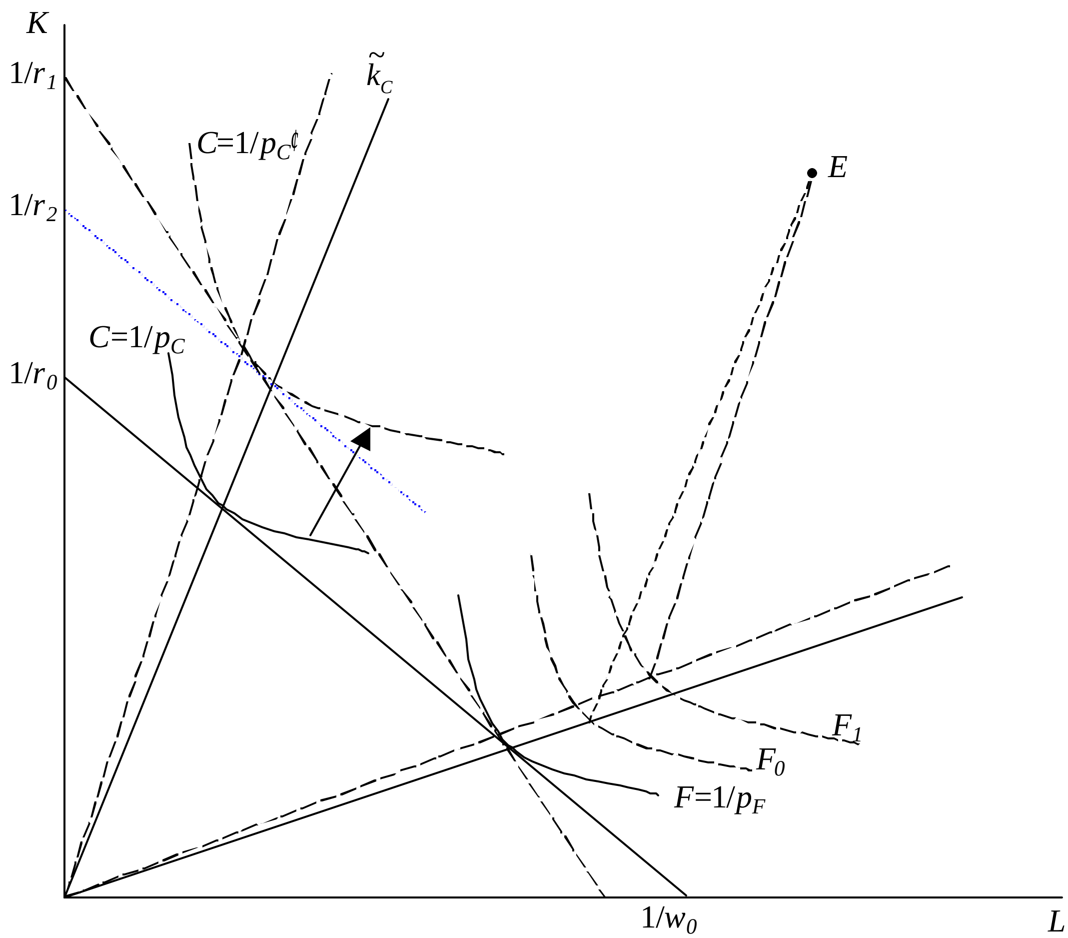
5. Use the HO Model with capital-intensive cloth and labor-intensive food to answer, for a small-open economy that is (and remains) diversified:

   a. If the labor force increases, what happens to the wage of labor and to labor's share of national income?



This moves the endowment point straight to the right, from E to E¢. Since by assumption we remain inside the diversification cone, this does not change factor prices. The wage remains at w_0. However, since this wage is now paid to more workers, while both the quantity and price of capital have not changed, the share of national income going to labor must have increased.

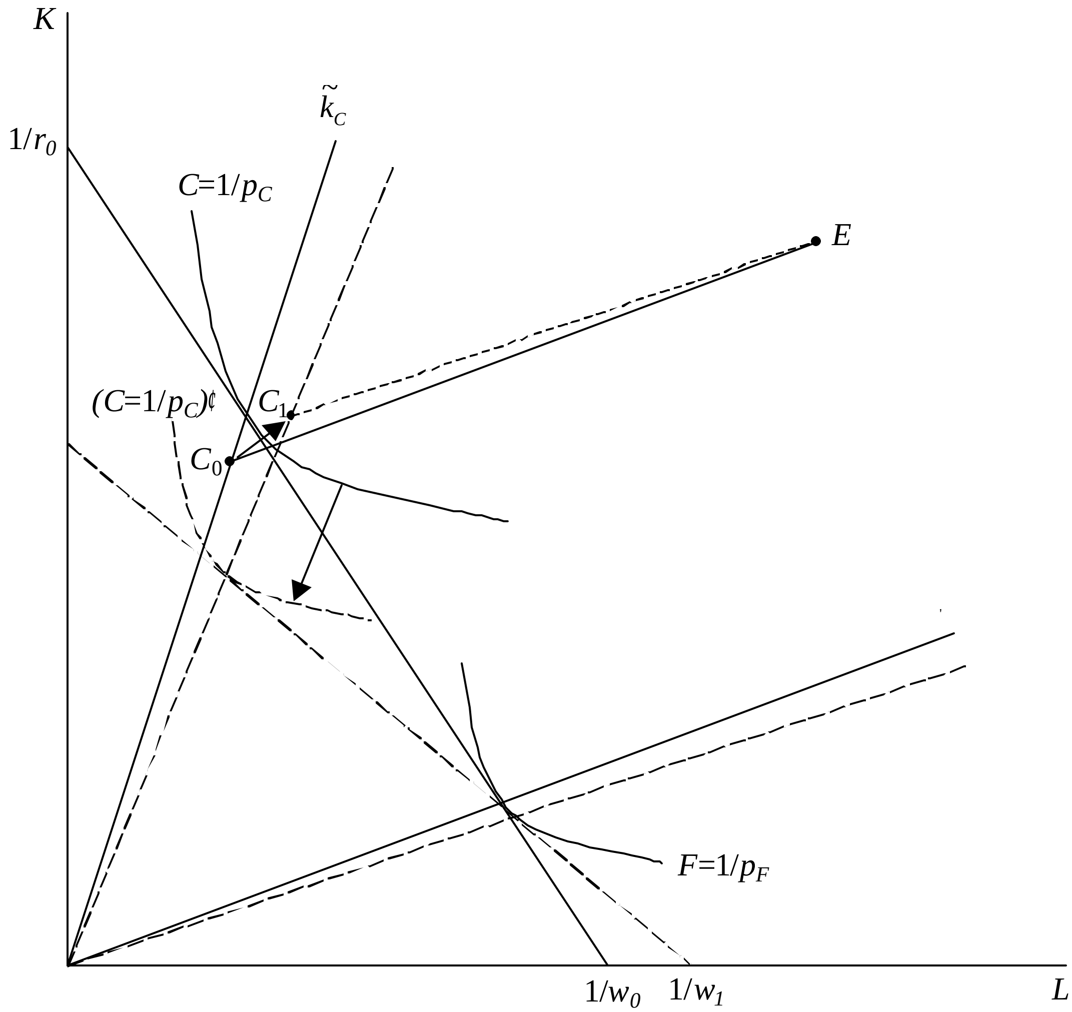
b. If the world price of cloth falls, what happens to the real rental on capital and to the output of food?



The fall in price of cloth shifts the unit-value isoquant for cloth outward from the origin as shown. This causes the common tangent to the two isoquants to become steeper, and also increases the capital-labor ratios employed in both industries. The rental on capital falls to r_1, which is a fall relative to the price of food, which has not changed. To compare it also to the price of cloth, which has fallen, we construct a line parallel to the original isocost line but tangent to the new cloth isoquant. This dotted line intercepts the vertical axis at $1/r_2$, and represents a fall in r equal to the fall in p_C. Since r_1 has fallen more than this, the rental must have fallen relative to the price of cloth as well, and this is a fall in real terms.

For the output of food, we complete one side of the parallelograms to get the outputs F_0 before the change and F_1 after. Clearly, the output of food has increased.

c. Suppose that technology improves in this country only, permitting it to produce more cloth with the same amounts of factors. What happens to its output of cloth and its real wage of labor?



This improvement in technology means that producers in the cloth industry can produce a dollar's worth of cloth using less factors. Thus the unit-value isoquant for cloth shifts inward, as shown. The new common tangent is flatter than the old one, intercepting the wage axis further to the right. This is a fall in the nominal wage, and since both goods prices are unchanged, it is a fall in the real wage too. As for the output of cloth, the parallelogram construction finds the factor allocations to the cloth industry at C_0 before the change and C_1 after, indicating that more of both factors is employed in cloth after the change. Since even the same amount of factors would have produced more cloth with the new technology, the output of cloth must increase.