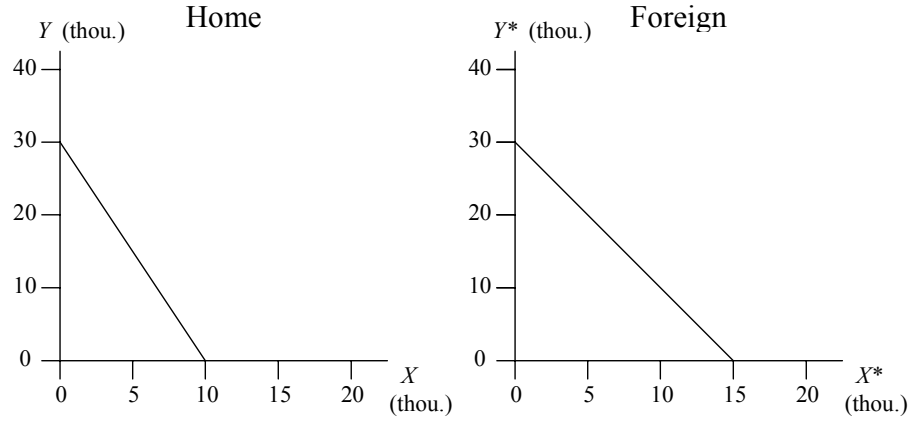
Midterm Exam No. 1 - *Answers*
July 16, 2003

Answer all questions, in blue book. Plan and budget your time. The questions are worth a total of 80 points, as indicated, and you will have 80 minutes to complete the exam.

1. [34 points] The graph below shows Ricardian production possibility frontiers for two countries, Home and Foreign, producing thousands of units of two goods, *X* and *Y*. Assume that Home is endowed with 50 units and Foreign with 60 units of labor.



   a. (4 points) What are the labor productivities (α, α*, β, β*, in units per worker) of the two countries in producing the two goods?

   The intercepts of the PPFs are, for example, αL/ = 10,000 and thus

   $\alpha = \bar{X} / L = 10{,}000/50 = 200.$

   Similarly,

   $\beta = \bar{Y} / L = 30{,}000/50 = 600.$

   $\alpha^* = \bar{X}^* / L^* = 15{,}000/60 = 250.$

   $\beta^* = \bar{Y}^* / L^* = 30{,}000/60 = 500.$

   b. (4 points) Which country, if any, has an absolute advantage in good *X*? Which has absolute advantage in good *Y*? Which has comparative advantage in good *X*? Which has comparative advantage in good *Y*? Show how you get your answers.

   Foreign has an absolute advantage in X, since its productivity is higher: 250>200.

   Home has an absolute advantage in Y, since its productivity is higher: 600>500.

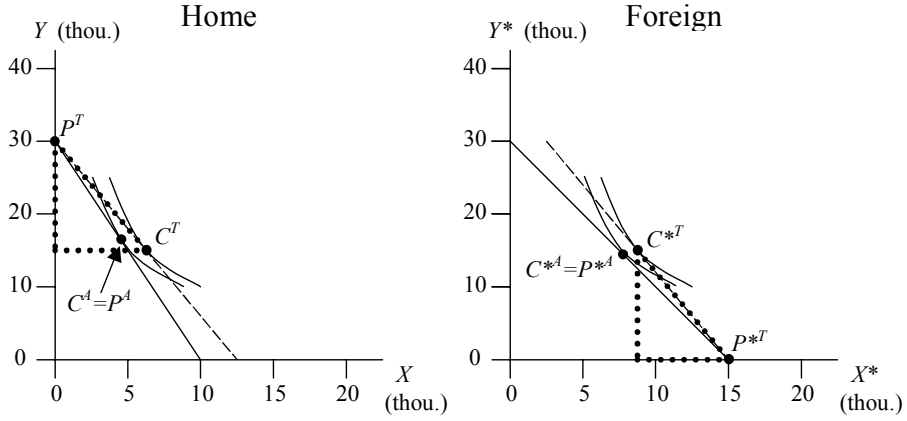
   Foreign also has a comparative advantage in X, since its productivity in X, relative to Y, is higher than Home's: 250/500=1/2>200/600=1/3.

   Home has a comparative advantage in Y, similarly: 600/200=3>500/250=2.

   c. (16 points) Copy the diagram into your blue book, keeping approximately the proportions (and thus absolute and comparative advantages) shown above. Then

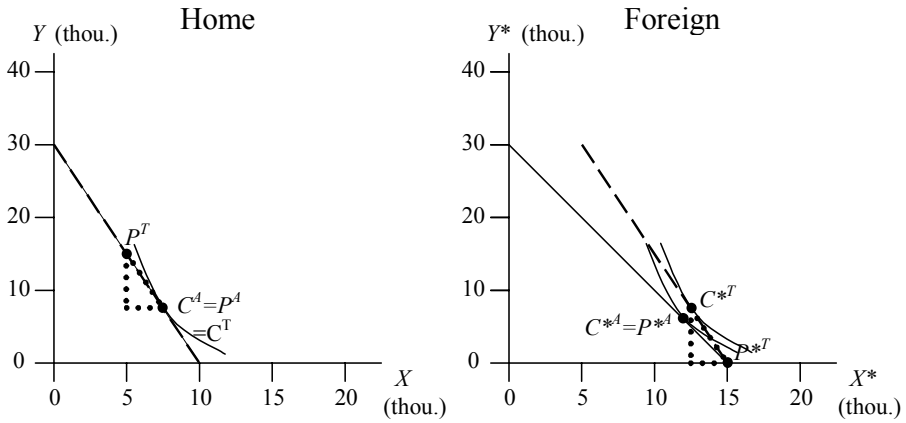
use the diagram as you've drawn it to illustrate, for plausible preferences, both autarky and free-trade equilibria for a world consisting only of these two countries. If there are quantities, distances, or slopes that should be equal in order for your diagram to represent equilibrium, be sure either that they look equal or that you say that they are. In your diagram, label the points where production takes place as P^A and P^{*A} for autarky in the Home and Foreign countries respectively, and P^T and P^{*T} for trade. Label the points where consumption takes place correspondingly as C^A, C^{*A}, C^T, and C^{*T}.

The diagram should look something like the following:



Trade equilibrium requires that the countries face the same relative price, hence the same slope for the dashed price lines through P^T and through P^{*T}, and also that the quantity of X that Home imports equals the quantity of X that Foreign exports, and vice versa for Y. All of this is assured if the two dotted trade triangles are identical in size and shape.

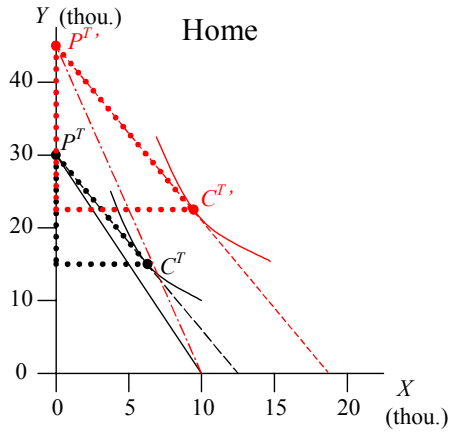
Since the countries are rather similar in size, an equilibrium like this, with both countries completely specialized, will arise if consumers demand the goods in more or less equal proportions, as they do above. You could also draw a valid equilibrium for preferences favoring one or the other of the goods with one of the countries producing both of them. In that case, the equilibrium might look something like the following:



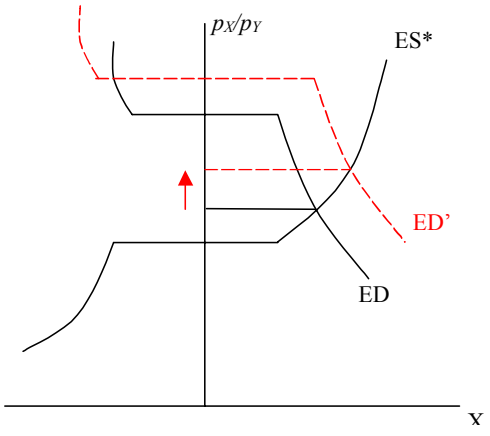
d. (10 points) Suppose now that labor productivity in the *Y* sector increases by 50% *in the Home country only*. On a separate page (that is, don't try to add this to the diagram of part (c)), but assuming the same initial free-trade equilibrium that you showed in part (c), use whatever tools you need to work out how this increase in productivity will affect the following. (Direction of change only.)

i. the world relative price of Food, and
ii. the real wage of labor in the Foreign country.

The shock here is a 50% increase in β, the output per worker in the Home country's Y industry. This increases the maximum that Home can produce of Y without changing the maximum it can produce of X. Thus it shifts the vertical intercept of the Home PPF upward as follows, drawn for the case in which Home completely specializes in the initial free-trade equilibrium.



At the initial prices, this increases the value of the country's (specialized) production and thus the income of consumers. If both goods are normal goods, then demand for both increases, as shown. Thus the Home country, which was an excess demander (importer) of good X initially, increases its excess demand at the initial price, thus shifting its excess demand curve out as shown below and raising the equilibrium relative price of X.



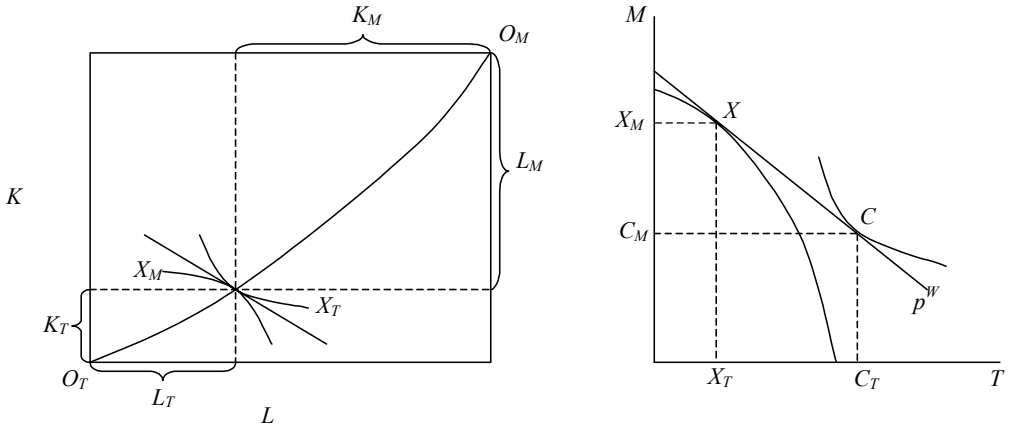
This price change could be added to the two PPFs above, but that is not necessary for the questions asked here. We've already got the price change.

As for the change in the real wage of Foreign labor, all that matters is the price, since the productivity of Foreign labor has not changed. Since its wage is therefore the same in terms of what it produces, X, and since that wage will now buy more of good Y, Foreign labor is better off.

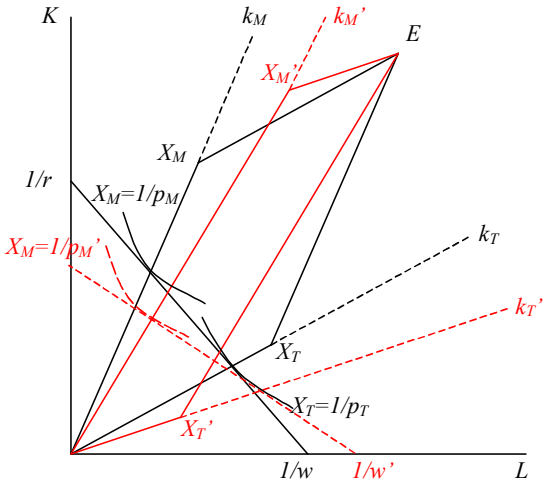
2. [28 points] Consider a small-open, two-sector, Heckscher-Ohlin economy in which two factors, capital and labor, produce labor-intensive textiles and capital-intensive machines.

   a. [8 points] Use the Edgeworth Box and the production possibility frontier (PPF) to illustrate production, consumption, and the allocation of factors to the two industries in an initial equilibrium in which the country produces both goods, and in which it exports machines. Be sure to label these things so that I can tell that you know what they are.

   Allocation within the Edgeworth Box is at a point of tangency between the isoquants for textiles, X_T, and for machines, X_M. Since textiles are assumed labor-intensive, this tangency lies below the diagonal of the box if, as shown, textiles are measured from its lower left. The outputs in the Edgeworth Box correspond to outputs on the PPF, shown on the right below. Production and consumption must lie on the same price line, p^W, which constitutes the aggregate budget line of consumers. Since the country is assumed to export machines, the production point, X, must lie closer to the M axis on this price line than the consumption point, C.



b. [12 points] Use the Lerner Diagram to show the effects of a small increase in the world relative price of machines (small enough that it continues to diversify) on



The Lerner Diagram starts from the two unit-value-isoquants shown as $X_T=1/p_T$ and $X_M=1/p_M$. The common tangent's intercepts tell, as 1/w and 1/r, the factor prices that permit production of both goods, and the points of tangency tell the capital-labor ratios needed to minimize costs at these factor prices, k_T and k_M. The parallelogram drawn using these capital-labor ratios identifies the allocations of factors to the M industry, at X_M, and to the T industry at X_T.

The increase in the price of M pulls the unit-value isoquant for M inward, as shown. The new common tangent is flatter than the old one, requiring (because of the lower relative wage) lower capital-labor ratios in both: k_T' and k_M'. These give us a new parallelogram with factor allocations at X_T' and X_M'.

i. Production of machines

From the figure, more of both factors are now employed in the machine industry, thus increasing its output.

ii. The employment of both factors in the textile industry

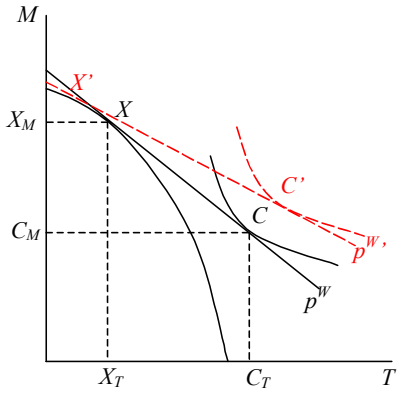
From the figure, less of both factors are now employed in the textiles industry.

iii. The real wage of labor

The new common tangent intercepts the L axis to the right of the old, indicating a fall in the nominal wage. Since the price of T has been held constant while the price of M has gone up, this is a fall in the real wage.

c. [8 points] In what sense, if any, does this country benefit from the price change in part (b)? Who in the country does, and who does not, share in the benefit or loss?

The effect of the price change on the country as a whole can be seen by introducing it into the PPF diagram from part (a):



Clearly, from the move to a higher indifference curve, the country seems to be better off due to this rise in the price of its export good, M. However, we saw in part (b) that the real wage goes down, so if the population includes people who derive their incomes solely from labor, then this group is made worse off. As we discussed in class, then, the rise in price causes only a ***potential*** *benefit to everyone in the economy, in the sense that it produces enough income to make everybody better off if some of it were redistributed to those who lose, in this case labor.*

3. [18 points] The figure on the next page (you may tear it off, if that will help you to look at it) shows three unit-value isoquants for industries 1, 2, and 3, corresponding to given prices p_1, p_2, and p_3. Three straight lines are also drawn, each tangent to two of them at the black dots shown, and extending to the labor and capital axes where they intersect at the amounts L_1, L_2, L_3, K_1, K_2, and K_3. Through the points of tangency are also drawn straight lines from the origin, labeled k_1, k_2, etc., which refer to the capital-labor ratios that are their slopes. These lines divide the space into seven regions, for each of which a country has been drawn with factor endowments at another black dot labeled E^1, etc.

   a. [10 points] Assume that these prices prevail initially in a world with free trade and identical constant-returns-to-scale technologies, so that all countries share the unit-value isoquants shown. Answer the following questions (no need to explain or show any work for this part):

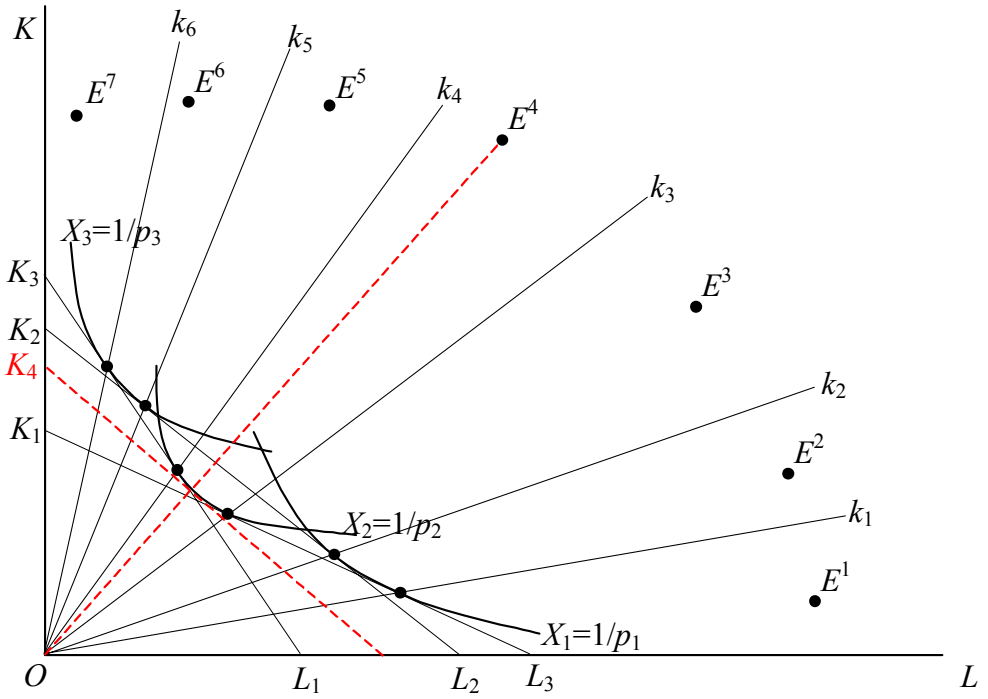
These prices give rise to the two-cone equilibrium that we discussed in class. The line tangent to the X_1 and X_3 unit-value isoquants is irrelevant, since if it determined factor prices, producers of X_2 would make a positive profit and nobody would produce X_1 or X_3. Since that line is irrelevant, so are the two rays from the origin passing through its tangencies, k_2 and k_5. The labor-intensive cone is therefore bounded by k_1 and k_3, while the capital-intensive cone is bounded by k_4 and k_6. The answers follow from the properties of the model that we learned using these two cones.

i. Which country or countries produce good 1?
   1, 2, and 3

ii. Which country or countries produce only one good?
   1 (produces only X_1), 4 (produces only X_2), and 7 (produces only X_3)

iii. What is the nominal wage of labor in country 3?
   $1/L_3$

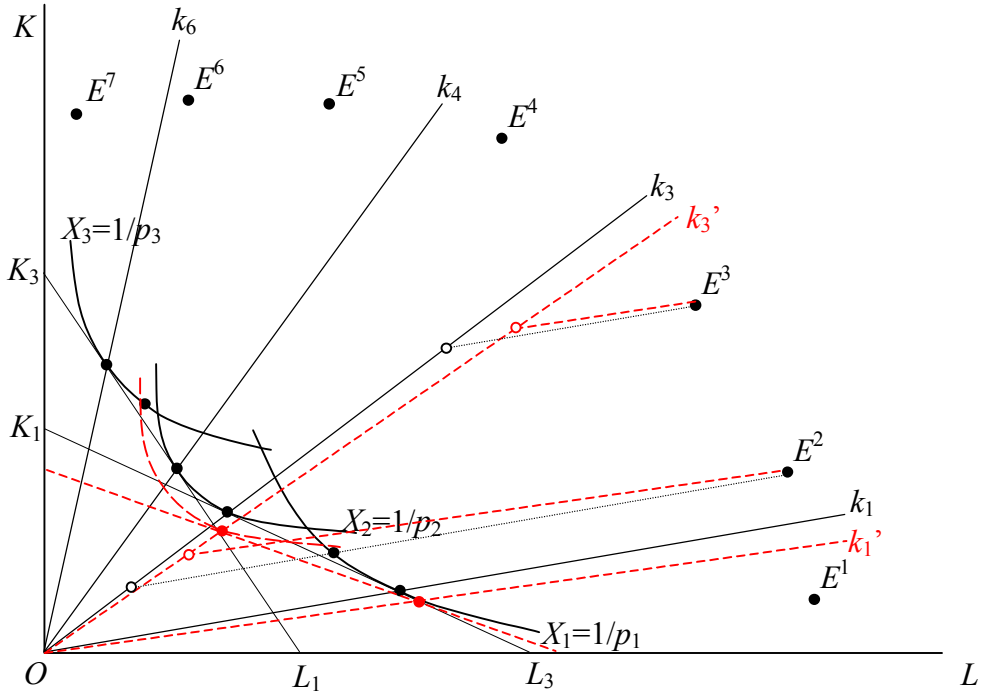
iv. What is the nominal rental price of capital in country 4?
   $1/K_4$ shown below. If you say somewhere between $1/K_1$ and $1/K_2$, that will be fine. (What you need here is to draw the ray from O to E^4, find where it crosses the X_2 isoquant, draw a tangent to that isoquant at that point, and see where it intersects the K axis.)



v. What is the capital-labor ratio employed in producing good 1 in country 3?
   k_1

b. [8 points] Suppose now that the price of good 2 were to increase by a small amount, the other prices remaining unchanged. In your blue book, draw enough of the diagram to allow you to illustrate this change and determine the changes in output of good 2 in countries 1, 2, 3, and 4. Explain your answers.

The rise in price of X_2 pulls its unit value isoquant inward as shown. This flattens its common tangent with X_1 (and steepens the one with X_3, but that isn't needed here), causing the capital-labor ratios to fall in both X_1 and X_2 for countries producing these goods in the labor-intensive cone. Thus the lines used to determine the factor allocations within this cone, which were k_1 and k_3, now become k_1' and k_3'.



Doing the construction, we find that factor employments increase in X_2 for both countries 2 and 3, and thus their output of good 2 increases.

Country 1 produces only good 1 before the price change and will continue to produce only good 1 afterwards if the price increase is small, as shown. Thus its output of good 2, zero, does not change.

Country 4 specializes completely in good 2 and continues to do so after the price change, regardless of its size. Since the technology has not changed and it continues to use all of its factors, in unchanged quantities, to produce good 2, its output of good 2 also does not change.