

Problem Set 1 - *Answers*

The Ricardian Model

1. Which of the following characterize the Ricardian Model?
 - a. Perfect mobility of factors across industries *Yes*
 - b. Perfect mobility of factors across countries *No*
 - c. Constant returns to scale *Yes (Almost trivially, since, with only one factor, a proportional increase in all factors is just an increase in labor. Since output is proportional to the labor input, this satisfies the definition of constant returns to scale: that a proportional increase in all inputs leads to an equal proportional increase in output.)*
 - d. The law of diminishing returns *No (Or one could say that it does not apply. That is, an increase in one factor input does not lead to a fall in its marginal product, as the law of diminishing returns would predict. But in this case there is no other factor input to be held fixed, as required for that law to apply.)*
 - e. Identical technologies across industries *No*
 - f. Identical technologies across countries *No*
 - g. Cournot competition *No*
 - h. Perfect competition *Yes*

2. Suppose that a small open economy has 200 workers and that its technology requires 1 worker-hour per unit of food and 3 worker-hours per unit of cloth. In autarky, it employs 100 workers in each of the two industries. With free trade, it faces world prices of \$10 per unit of food and \$20 per unit of cloth.
 - a. Suppose that in autarky, workers in both industries are paid \$8 per hour. What are the autarky prices of food and cloth?
Prices of the goods are just their costs of production: $p_F = 8 \cdot 1 = \$8$ per unit of Food; $p_C = 8 \cdot 3 = \$24$ per unit of Cloth.

 - b. When the country opens to free trade, under the normal assumptions of the Ricardian model, what will it produce, import, and export? From the information given, can you determine the quantities of any of these? What is the country's national income with trade, measured in dollars?
The country has a comparative advantage in Food, since $a_{LF}/a_{LC} = 1/3$ while $p_F/p_C = 10/20 = 1/2$, and thus $a_{LF}/a_{LC} < p_F/p_C$. It will therefore specialize completely in producing Food, moving all of its 200 workers there. Its output of food (per hour) will be 200 units, while its output of Cloth will be zero.

Producing only Food, but demanding both goods, it will export Food and import Cloth. We cannot determine the quantities of exports and imports without more information about the structure of demand. National income is $10 \cdot 200 = \$2000$ per hour. (If we follow Mikic in assuming Cobb-Douglas preferences – which she assumes implicitly on page 16 – then we can say more. Since in autarky 100 workers were employed in both industries, paid the same wages, consumers must have been spending half of their incomes on each good. With an income of \$2000 with trade, they will spend \$1000 on Food, buying $1000/10 = 100$ units, and thus exporting 100 units also. They will spend \$1000 on Cloth, buying $1000/20 = 50$ units, which they will import.)

- c. Suppose, contrary to the normal Ricardian Model assumptions, that when trade is opened, workers are unwilling or unable to change occupations, so that we continue to have 100 workers in each industry. What, then, is the national income of the country, in dollars, and how does it compare to the national income you got in part (b) when workers were mobile?

The 100 workers in the Food industry produce $100/1 = 100$ units of Food per hour, while the 100 workers in Cloth produce $100/3 = 33.3$ units of Cloth per hour. At world prices, national income is therefore $10 \cdot 100 + 20 \cdot 33.3 = \1666.7 . This is smaller than national income in part (b) by \$333.3, which indicates the cost to the country of this labor immobility.

- d. What are the wages of the two groups of workers in part (c)?

Workers are paid the value of their marginal product, which is the reciprocal of the unit labor requirement in their industry. Thus in the Food industry, $w_F = p_F/a_{LF} = 10/1 = \10 per hour. In the Cloth industry, $w_C = p_C/a_{LC} = 20/3 = \6.67 per hour.

- e. [This should be challenging.] Do you think that the country gains from trade in part (c)? Who gains and who loses within it?

From what you have studied so far (just the Ricardian Model) you would be justified in thinking that the country does not gain from trade in this case, since there is no change in production and therefore no taking advantage of comparative advantage. However, when we get to the gains from trade topic somewhat later in the course, you will learn that countries in general gain from changing both production and consumption, and that is the case here as well. In fact, even though production does not change in part (c), if consumers are willing to substitute towards the good that has become cheaper with trade (Cloth), then they will achieve a higher utility in the aggregate, and gain from trade.

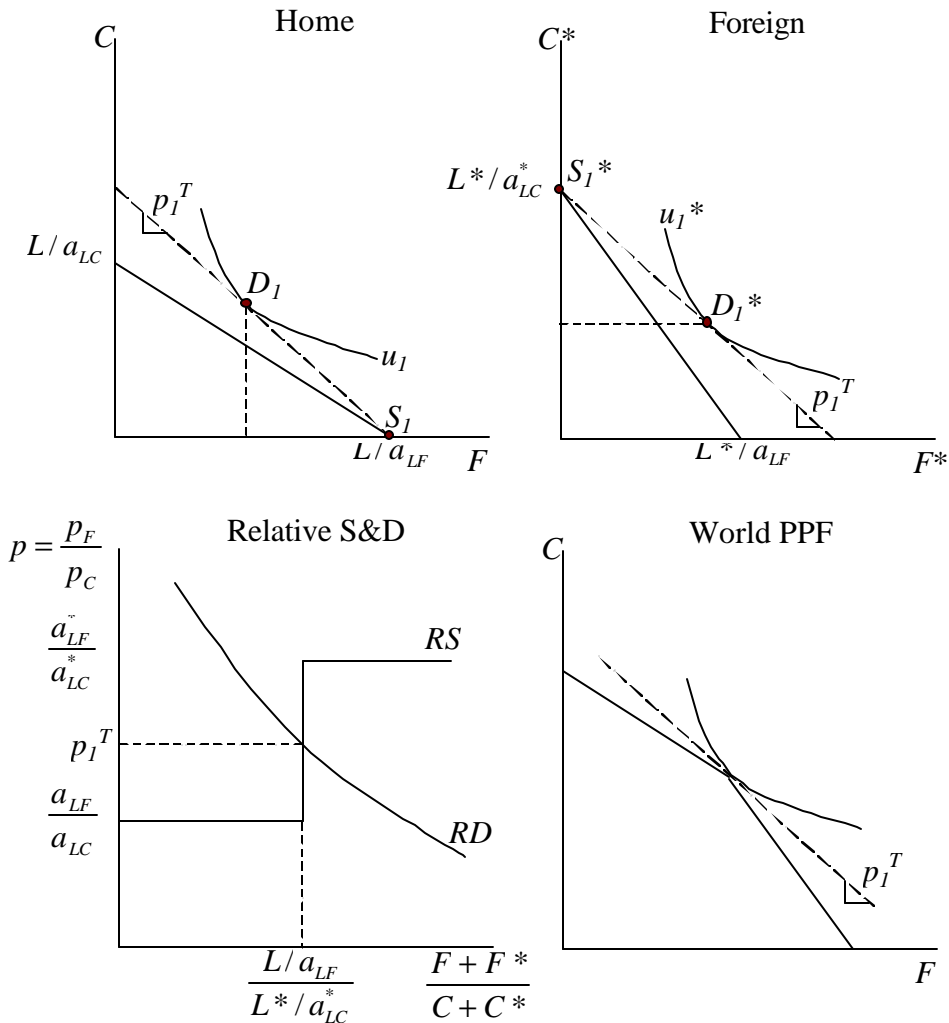
As for who gains and who loses, you can see by comparing the answer to part (d) to the \$8 wage in autarky that the nominal wage has risen, due to trade, for workers in the Food industry and it has fallen for workers in the Cloth

industry. This does not quite tell you that these groups have gained and lost, respectively, however, since they also face different prices as consumers. That is, the price of Food has gone up for them, while the price of Cloth has gone down. Comparing the sizes of these changes to the changes in wages, you may note that the wage in Food has risen by the same percentage (25%) as its price, so that workers there are better off as long as they want to consume any at all of Cloth. Likewise, the wage in Cloth has fallen by the same percentage as its price ($1/6=16.7\%$), so that workers there are worse off as long as they want to consume any at all of Food.

3. Using the same assumptions at the start of problem 2, but returning to the usual assumption that labor can move between industries, suppose that the wage of labor in the country in autarky were \$15 per hour instead of \$8.
 - a. Now what would be the autarky prices of Food and Cloth?
Now $p_F = 15 \cdot 1 = \$15$ per unit and $p_C = 15 \cdot 3 = \$45$ per unit.
 - b. When the country opens to free trade, what will happen? How will your answers to part (b) of problem 2 be changed?
Both prices will now fall, in dollar terms, from \$15 to \$10 for Food and from \$45 to \$20 for Cloth, and this will require a fall in the nominal wage, as shown below. But none of this actually matters for the answers to part (b) of problem 2, which asked only about real (not nominal) changes, except for national income. The higher nominal wage and prices in autarky has not changed the fact that the country has a comparative advantage in Food, and it will still, as a result, specialize completely in that sector. The quantities produced, exported, and imported will therefore all be the same. And since national income depends on the prices with trade, not without, its value is the same also.
 - c. What is the wage of labor with free trade, in dollars?
Labor is again paid the value of its marginal product, in the Food industry since that is all it is producing: $w = p_F/a_{LF} = 10/1 = \10 per hour. The nominal wage has therefore fallen by 1/3.
 - d. What has happened, as a result of trade, to the real wages of labor?
For this we must compare nominal wages to the prices of the two goods. The price of Food has fallen from \$15 per unit to \$10, the same as the wage, so workers are neither better nor worse off in terms of their ability to buy food. But the price of Cloth has fallen from \$45 to \$20 per unit, or by more than half, so they can now buy more Cloth with an hour of labor than before. So all but the nudists among them are better off.

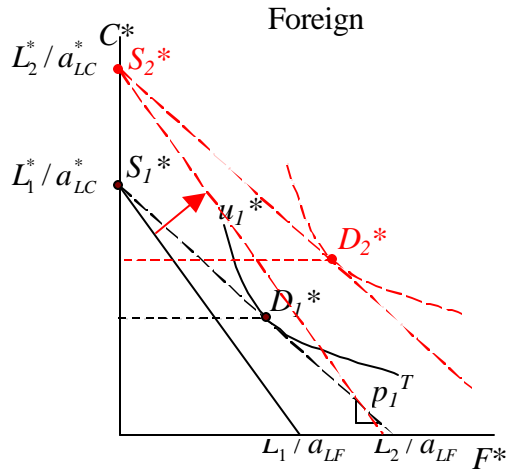
4. Use the 2-country Ricardian Model with free trade to work out the effects of the following changes (one at a time) on the Home country's terms of trade and welfare. Assume that the Home country has a comparative advantage in Food, and that in the initial equilibrium, both countries specialize completely. You may assume, if it is helpful, that preferences are identical and homothetic in the two countries.

The initial equilibrium can be depicted several ways. The top panels show PPFs for both countries, together with (parallel) world price lines and (identical) trade triangles. The bottom-left panel shows world relative supply and demand, intersecting at the initial equilibrium world relative price, p_1^T . The bottom-right panel shows the world PPF and equilibrium world consumption. Answers to the three parts of this question will be derived by introducing changes into some of these panels. Whether you use the lower-left or lower-right panels (relative supply and demand, versus world PPF) is up to you – there is no need to use both.

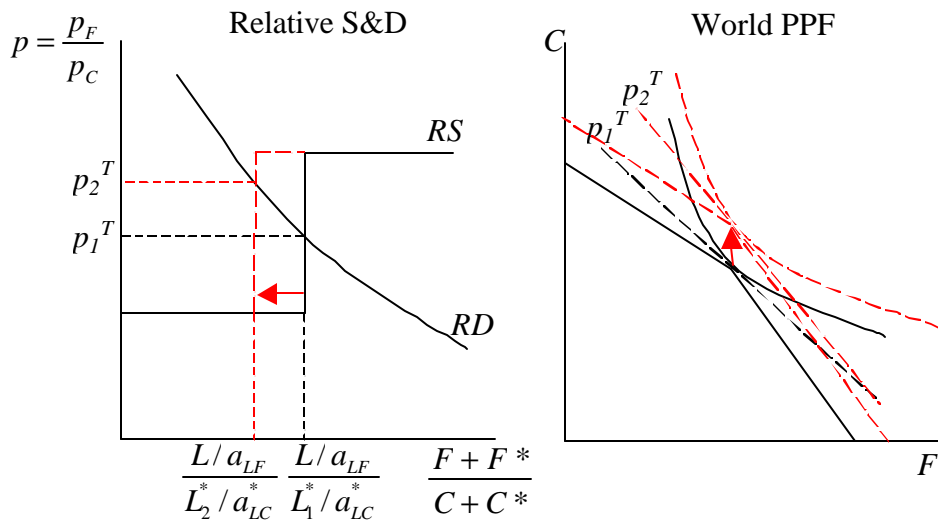


- a. An increase in the Foreign labor force.

This increase in L^ , from L_1^* to L_2^* , shifts the Foreign PPF outward without changing its slope.*

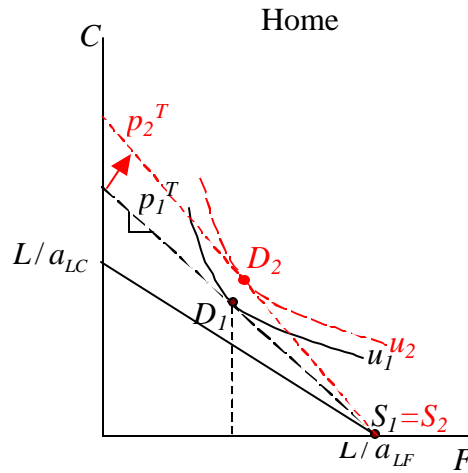


At the initial price, Foreign increases its exports of C and imports of F as shown. This causes the world relative price of F to rise (and of C to fall), as can be seen in the bottom panels from the leftward shift of the vertical portion of RS, and from the upward movement of the kink of the world PPF, which moves consumption to a steeper part of a world indifference curve.



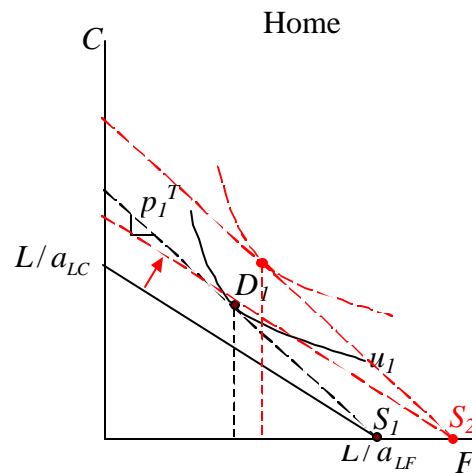
Turning to the Home PPF diagram from the original top-left panel, this rise in the world relative price of food is an improvement in Home's terms of trade, and it permits Home to trade its exports of Food for more Cloth, as shown below. Home

reaches a higher indifference curve, indicating that its people have gained from this expansion of the foreign labor force.



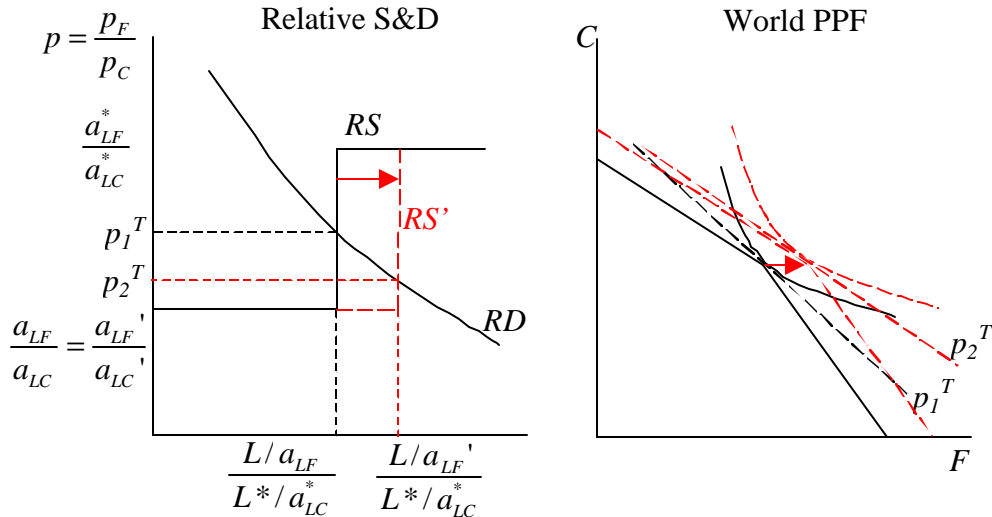
- b. A decrease, of the same percentage in both industries, in the Home country's unit labor requirements for producing both Food and Cloth.

This makes it possible for Home to produce more Food, more Cloth, or more of both, appearing as an outward shift of its PPF much like the one for Foreign in part (a):

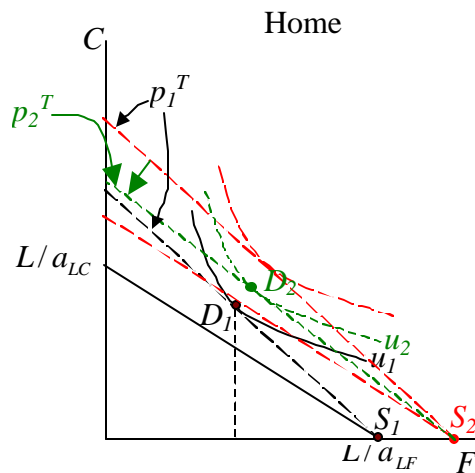


As was the case for Foreign, Home now will increase both its exports (of Food) and imports (of Cloth), if prices do not change. But they will change, and in the opposite direction from part (a). Since Home is now exporting more Food to the

world market, its price will fall. This can be seen in either of the bottom-panel diagrams below:

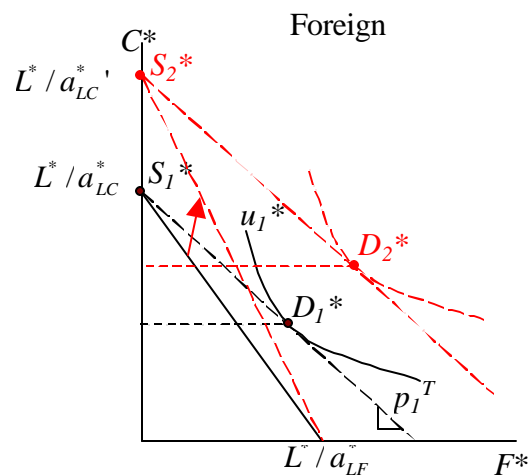


This fall in the world price of Food is a worsening of Home's terms of trade, and it tends to make it worse off, partially or wholly offsetting the benefit from the improved technology. In the case shown below, the offset is only partial, but you could easily draw it as leading to a lower indifference curve than the country started on. This would be a case of "immiserizing growth," as we will study later in the course.

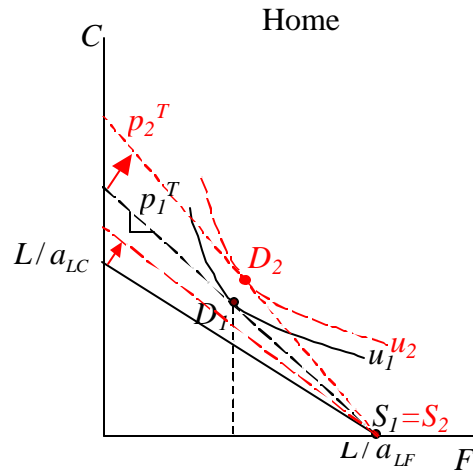


- c. A decrease, of the same percentage in both countries, in the unit labor requirements for producing Cloth.

This makes it possible for both countries to produce more Cloth, without changing their capacity to produce Food. Since the ratios a_{LF} / a_{LC} and a_{LF}^ / a_{LC}^* both rise by the same percentage, it remains true that Home has a comparative advantage in Food and produces only Food. Therefore the fall in a_{LC} is irrelevant. The fall in a_{LC}^* is not irrelevant, however, shifting the Foreign PPF to a higher vertical intercept without changing its horizontal intercept:*



Although the cause is different, the effect on Foreign's behavior is the same as the population increase in part (a): it increases its exports of Cloth and its imports of Food at the initial price. The effect on world markets and the world price is therefore also the same as in part (a), with the world relative price of food rising. Returning to the Home country, this has essentially the same effect on it as in part (a), although the picture differs slightly due to the extra (and irrelevant) shift in its PPF:



5. [This is short, but it may be challenging.] The assumptions of the Ricardian Model include balanced trade. However, this assumption does not appear explicitly in any of the steps we took to solve the model. What is it that assures that trade is in fact balanced in the equilibria that we look at?

Trade balance is assured by our assumption that countries' expenditure on goods exactly equals the income they earn from production. That is, when we assumed that consumers get an income that is equal to the value of the goods produced, and that they spend all of that income on goods, we were implicitly assuming that trade would be balanced. The reason is that a trade imbalance necessarily implies that a country is either spending less than its income (a trade surplus) or spending more than its income (a trade deficit).