2

Trade and Technology: The Ricardian Model

1. At the beginning of the chapter there is a brief quotation from David Ricardo; here is a longer version of what Ricardo wrote:

> England may be so circumstanced, that to produce the cloth may require the labour of 100 men for one year; and if she attempted to make the wine, it might require the labour of 120 men for the same time. . . .To produce the wine in Portugal, might require only the labour of 80 men for one year, and to produce the cloth in the same country, might require the labour of 90 men for the same time. It would therefore be advantageous for her to export wine in exchange for cloth. This exchange might even take place, notwithstanding that the commodity imported by Portugal could be produced there with less labour than in England.

Suppose that the amount of labor he describes can produce 1,000 yards of cloth or 1,000 bottles of wine in either country. Then answer the following:

a. What is England's marginal product of labor in cloth and in wine, and what is Portugal's marginal product of labor in cloth and in wine? Which country has absolute advantage in cloth and in wine, and why?

Answer: In England, 100 men produce 1,000 yards of cloth, so MPL_C = 1,000/100 = 10. 120 men produce 1,000 bottles of wine, so MPL_W = 1,000/120 = 8.3. In Portugal, 90 men produce 1,000 yards of cloth, so MPL^*_C = 1,000/90 = 11.1. 80 men produce 1,000 bottles of wine, so MPL^*_W = 1,000/80 = 12.5. So Portugal has an absolute advantage in both cloth and wine, because it has higher marginal products of labor in both industries than does England.

b. Use the formula $P_W/P_C = MPL_C/MPL_W$ to compute the no-trade relative price of wine in each country. Which country has comparative advantage in wine, and why?

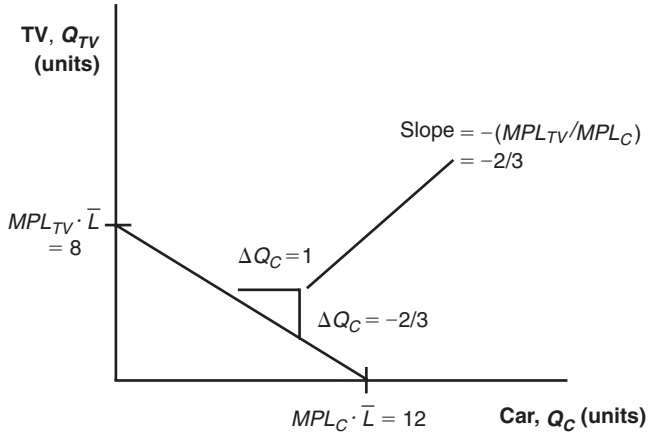
Answer: For England, $P_W/P_C = MPL_C/MPL_W$ = 10/8.3 = 1.2, which is the no-trade relative price of wine (equal to the opportunity cost of producing wine). So the opportunity cost of wine in terms of cloth is 1.2, meaning that to

produce 1 bottle of wine in England, the country gives up 1.2 yards of cloth. For Portugal, $P^*_W/P^*_C = MPL^*_C/MPL^*_W = 11.1/12.5 = 0.9$, which is the no-trade relative price of wine (equal to the opportunity cost of producing wine). The no-trade relative price of wine is lower in Portugal, so Portugal has comparative advantage in wine, and England has comparative advantage in cloth. Portugal has comparative advantage in producing wine because it has lower opportunity cost ($P^*_W/P^*_C = 0.9$) than England in the production of wine ($P_W/P_C = 1.2$).

2. Suppose that each worker in the Home country can produce three cars or two TVs. Assume that Home has four workers.

a. Graph the production possibilities frontier for the Home country.

Answer: See the following figure.



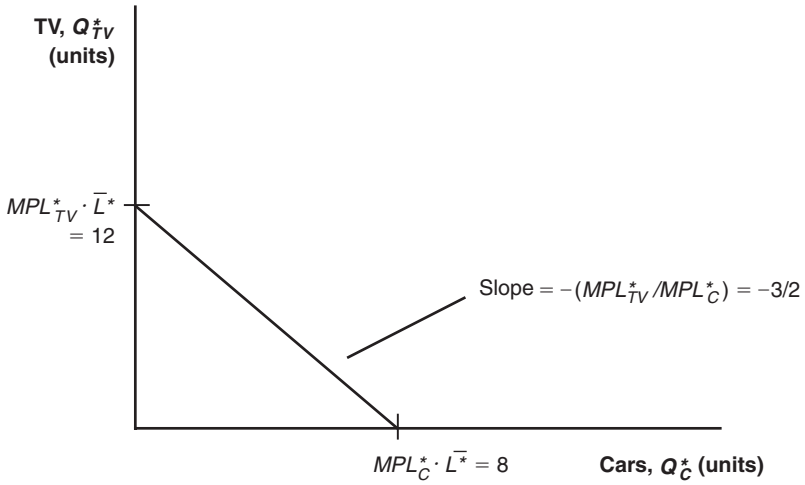
b. What is the no-trade relative price of cars at Home?

Answer: The no-trade relative price of cars at Home is $P_C/P_{TV} = 2/3 = MPL_{TV}/MP_C$. It is the slope of the PPF curve for Home.

3. Suppose that each worker in the Foreign country can produce two cars or three TVs. Assume that Foreign also has four workers.

a. Graph the production possibilities frontier for the Foreign country.

Answer: See following figure.



b. What is the no-trade relative price of cars in Foreign?

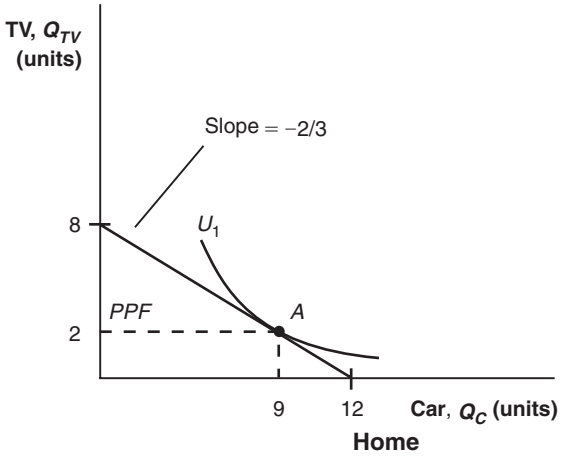
Answer: The no-trade relative price of cars in Foreign is $P^*_C/P^*_{TV} = 3/2 = MPL_{TV}/MPL^*_C$, or the slope of the PPF curve for the Foreign country.

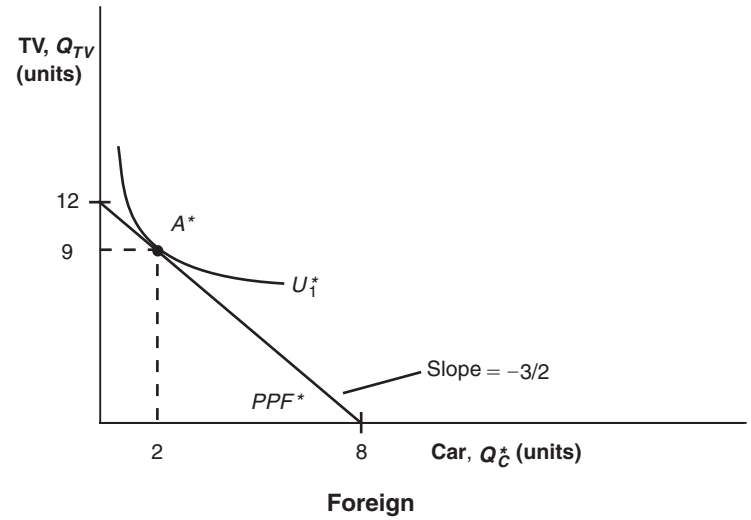
c. Using the information provided in Problem 2 regarding Home, in which good does Foreign have a comparative advantage and why?

Answer: Foreign has a comparative advantage in producing televisions because it has a lower opportunity cost than Home in the production of televisions.

4. Suppose that in the absence of trade, Home consumes nine cars and two TVs and Foreign consumes two cars and nine TVs. Add the indifference curve for each country to the figures in Problems 2 and 3. Label the production possibilities frontier (PPF), indifference curve (U_1), and the no-trade equilibrium consumption and production for each country.

Answer: See following figures.





5. Now suppose the world relative price of cars is $P_C/P_{TV} = 1$.

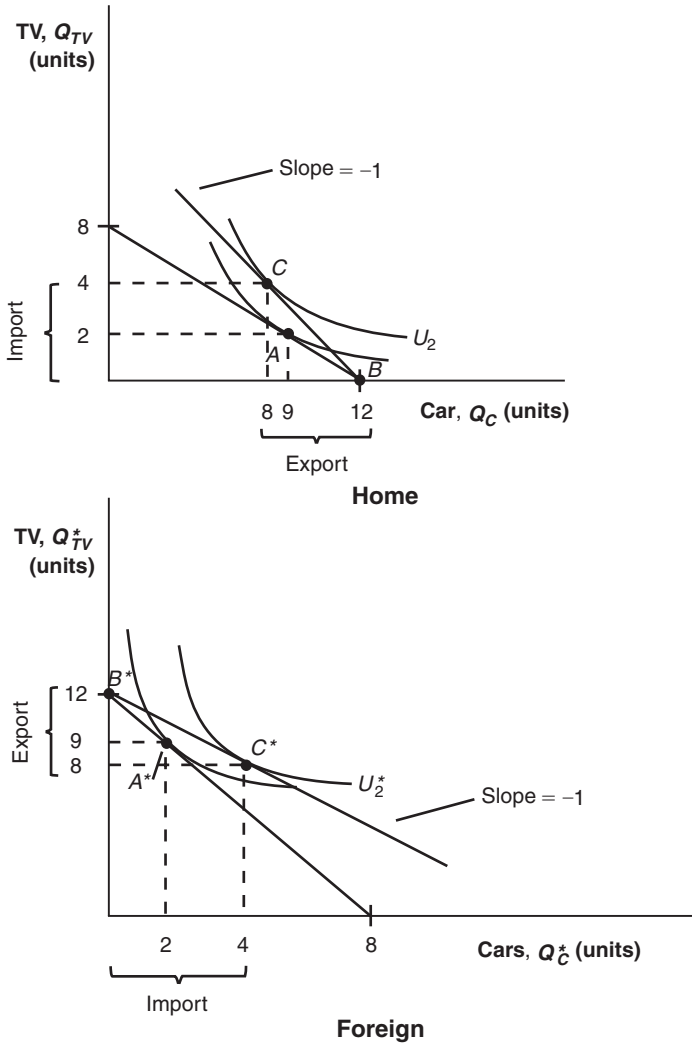
a. In what good will each country specialize? Briefly explain why.

Answer: Home would specialize in cars, export cars, and import televisions, whereas the Foreign country would specialize in televisions, export televisions, and import cars. The reason is because Home has a comparative advantage in

cars and Foreign has a comparative advantage in televisions. The relative price of a car in home is ($P_C/P_{TV} = 2/3$), which is lower than the world price of 1. So Home will export cars and earn a profit. The world relative price of a television is 1, higher than that in Foreign ($P^*_{TV}/P^*_C = 2/3$). So Foreign will specialize in producing televisions, and export televisions to the world market.

b. Graph the new world price line for each country in the figures in Problem 4 and add a new indifference curve (U_2) for each country in the trade equilibrium.

Answer: See the following figures.



c. Label the exports and imports for each country. How does the amount of Home exports compare with Foreign imports?

Answer: See graph in part (b). The amount of Home car exports is equal to the amount of Foreign car imports. In addition, Home imports of televisions equal Foreign exports of televisions. This is balanced trade, which is an essential feature of the Ricardian model.

d. Does each country gain from trade? Briefly explain why or why not.

Answer: Both Home and Foreign benefit from trade relative to their no-trade consumption because they are able to consume at higher indifference curves.

6. Answer the following question using the information given by the accompanying table.

	Home Country	Foreign Country	Absolute Advantage
Number of bicycles produced per hour	4	2	***Home/Foreign ratio*** 2
Number of snowboards produced per hour	6	8	***Home/Foreign ratio*** 3/4
Comparative advantage	$\frac{MPL_S}{MPL_B} = \frac{3}{2}$	$\frac{MPL_S^*}{MPL_B^*} = 4$	

a. Complete the previous table in the same manner as Table 2-2.

Answer: See previous table.

b. Which country has an absolute advantage in the production of bicycles? Which country has an absolute advantage in the production of snowboards?

Answer: Home has an absolute advantage in the production of bicycles because it is able to produce more bicycles in an hour than Foreign.

c. What is the opportunity cost of bicycles in terms of snowboards at Home? What is the opportunity cost of bicycles in terms of snowboards in Foreign?

Answer: Foreign has an absolute advantage in the production of snowboards because it is able to produce more snowboards in an hour than Home.

d. Which product will Home export, and which product does Foreign export? Briefly explain why.

Answer: The opportunity cost of one bicycle is 3/2 snowboards at Home ($P_B/P_S = MPL_S/MPL_B = 6/4 = 3/2$). The opportunity cost of one bicycle is 8/2 snowboards in the foreign country ($P^*_B/P^*_S = MPL^*_S/MPL^*_B = 8/2 = 4$). Home has a smaller opportunity cost producing bicycles than the Foreign.

7. Assume that Home and Foreign produce two goods, TVs and cars, and use the following information to answer the questions:

In the no-trade equilibrium:

Home Country		Foreign Country	
$Wage_{TV} = 12$	$Wage_C = ?$	$Wage^*_{TV} = ?$	$Wage^*_C = 6$
$MPL_{TV} = 2$	$MPL_C = ?$	$MPL^*_{TV} = ?$	$MPL^*_C = 1$
$P_{TV} = ?$	$P_C = 4$	$P^*_{TV} = 3$	$P^*_C = ?$

a. What is the marginal product of labor for TVs and cars in the Home country? What is the no-trade relative price of TVs at Home?

Answer: $MPL_C = 3$, $MPL_{TV} = 2$, and $P_{TV}/P_C = MPL_C/MPL_{TV} = 3/2$

b. What is the marginal product of labor for TVs and cars in the Foreign country? What is the no-trade relative price of TVs in Foreign?

Answer: $MPL^*_C = 1$, $MPL^*_{TV} = 2$, and $P^*_{TV}/P^*_C = MPL^*_C/MPL^*_{TV} = 1/2$

c. Suppose the world relative price of TVs in the trade equilibrium is $P_{TV}/P_C = 1$. Which good will each country export? Briefly explain why.

Answer: Home will export cars and Foreign will export televisions because Home has a comparative advantage in cars whereas Foreign has a comparative advantage in televisions. Each country will specialize in the goods with lower

opportunity cost. No-trade price of televisions in Foreign is 1/2, lower than the world price of 1. So Foreign will specialize in televisions, export televisions, but import cars. Autarky price of cars in Home is 2/3, lower than the world price of 1. So Home will specialize in cars, export cars, and import televisions.

d. In the trade equilibrium, what is the real wage at Home in terms of cars and in terms of TVs? How do these values compare with the real wage in terms of either good in the no-trade equilibrium?

Answer: Workers at Home are paid in terms of cars because Home exports cars. Home is better off with trade because its real wage in terms of televisions has increased.

$$\text{Home wages with trade} = \begin{cases} MPL_C = 3 \text{ units of car} \\ \text{or} \\ (P_C/P_{TV}) \cdot MPL_C = (1) \cdot 3 = 3 \text{ units of TV} \end{cases}$$

$$\text{Home wages without trade} = \begin{cases} MPL_C = 3 \text{ units of car} \\ \text{or} \\ (P_C/P_{TV}) \cdot MPL_C = (2/3) \cdot 3 = 2 \text{ units of TV} \end{cases}$$

e. In the trade equilibrium, what is the real wage in Foreign in terms of TVs and in terms of cars? How do these values compare with the real wage in terms of either good in the no-trade equilibrium?

Answer: Foreign workers are paid in terms of televisions because Foreign exports televisions. Foreign gains in terms of cars with trade.

$$\text{Foreign wages with trade} = \begin{cases} (P_{TV}/P_C) \cdot MPL^*_{TV} = (1) \cdot 2 = 2 \text{ units of cars} \\ \text{or} \\ MPL^*_{TV} = 2 \text{ units of TV} \end{cases}$$

$$\text{Foreign wages without trade} = \begin{cases} (P^*_{TV}/P^*_C) \cdot MPL^*_{TV} = (1/2) \cdot 2 = 1 \text{ unit of car} \\ \text{or} \\ MPL^*_{TV} = 2 \text{ units of TV} \end{cases}$$

f. In the trade equilibrium, do Foreign workers earn more or less than those at Home, measured in terms of their ability to purchase goods? Explain why.

Answer: At the trade equilibrium, real wages for Foreign workers are either 2 cars or 2 televisions, whereas real wages for Home workers are either 3 televisions or 3 cars. Foreign workers earn less than workers at Home in terms of cars because Home has an absolute advantage in the production of cars. Home workers also earn more than Foreign workers in terms of televisions. Under the Ricaridan model, wage differences are determined by absolute advantage or *MPL* (productivity).

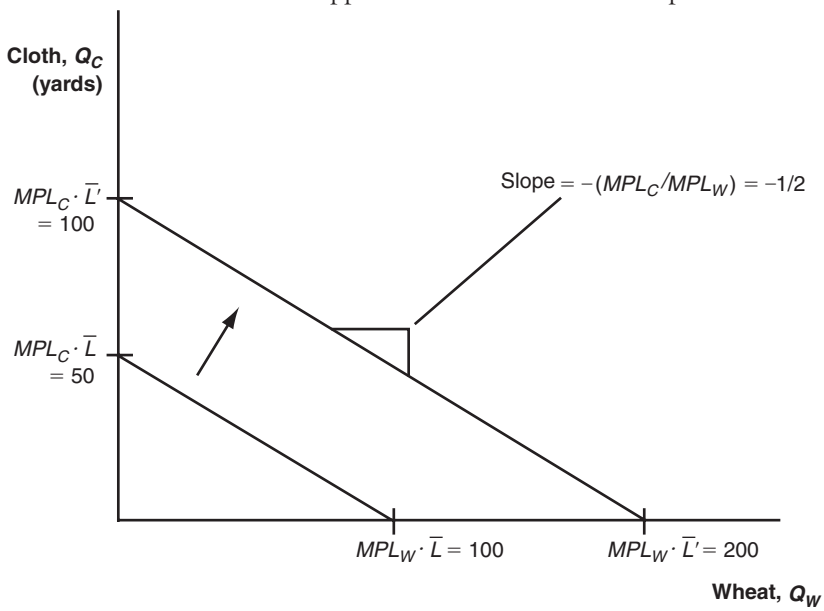
8. Why do some low-wage countries, such as China, pose a threat to manufacturers in industrial countries, such as the United States, whereas other low-wage countries, such as Haiti, do not?

Answer: To engage in international trade, a country must have a minimal threshold of productivity. Countries such as China have the productivity necessary to compete successfully, but Haiti does not. China can enter the world market because it beats other industrial countries with a lower price. Under perfect competition, price is determined by both wage rate and productivity; that is, $P = Wage/MPL$. So the lower price in China comes from both a low wage rate and

high *MPL*. Haiti has a low wage rate, but also low *MPL*. So Haiti's price is not low enough to enter the world market.

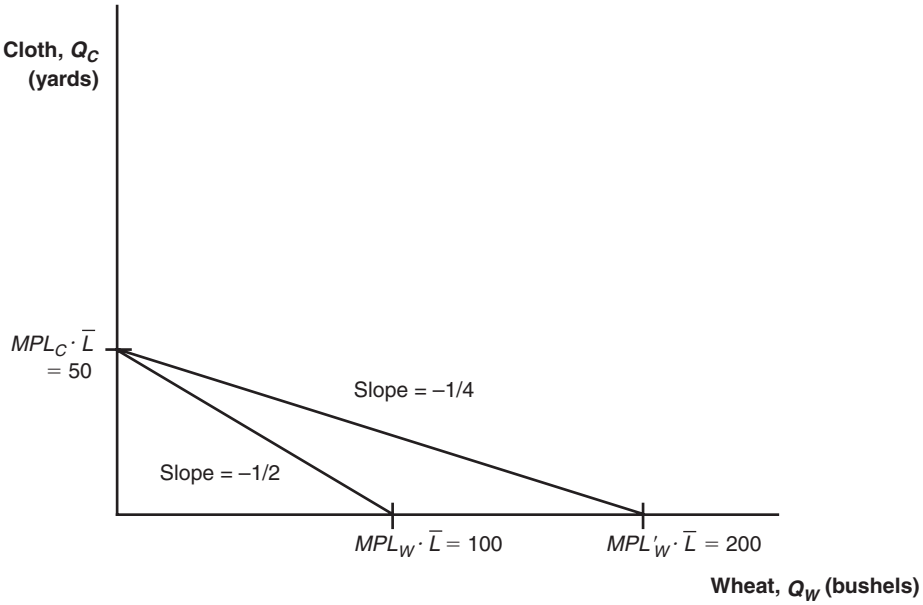
Answer Problems 9 through 11 using the chapter information for Home and Foreign.

9. a. Suppose that the number of workers doubles in Home. What happens to the Home PPF and what happens to the no-trade relative price of wheat?



Answer: With the doubling of the number of workers in Home, it can now produce $200 = 4 \cdot 50$ bushels of wheat if it concentrates all resources in the production of wheat, or it could produce $100 = 2 \cdot 50$ yards of cloth by devoting all resources to the production of cloth. The PPF shifts out for both wheat and cloth. The no-trade relative price of wheat remains the same because both MPL_W and MPL_C are unchanged.

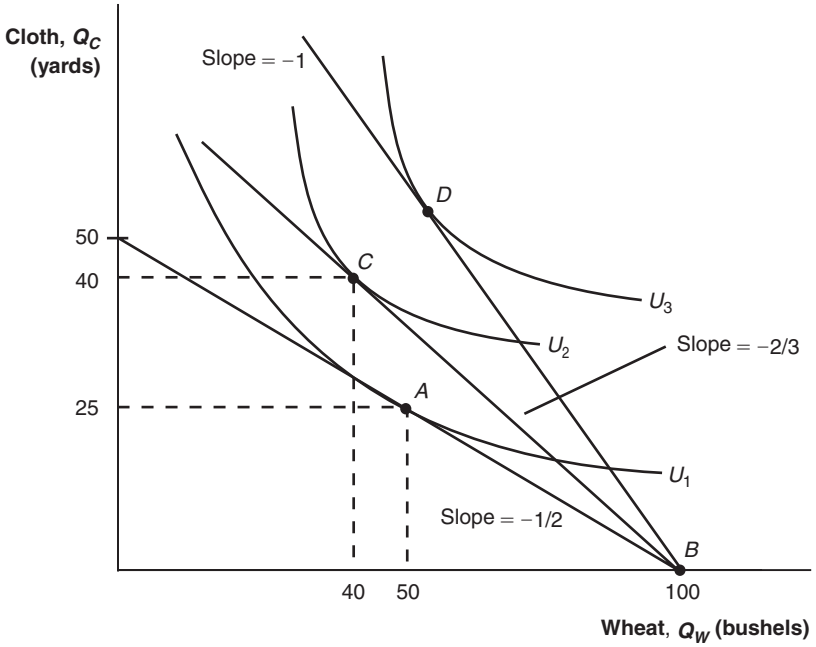
b. Suppose that there is technological progress in the wheat industry such that Home can produce more wheat with the same amount of labor. What happens to the Home PPF, and what happens to the relative price of wheat? Describe what would happen if a similar change occurred in industry.



Answer: Because the technological progress is only in the wheat industry, Home's production of cloth remains the same if it devotes all of its resources to producing cloth. If instead Home produces only wheat, it is able to produce more wheat using the same amount of labor. Home's PPF shifts out in the direction of wheat production. Recall that the relative price of wheat is given by $P_W/P_C = MPL_C/MPL_W$. With the technological progress in wheat, the marginal product of labor in the wheat production increases. Thus, the relative price of wheat decreases. As shown in the graph, the relative price of wheat drops from 1/2 to 1/4.

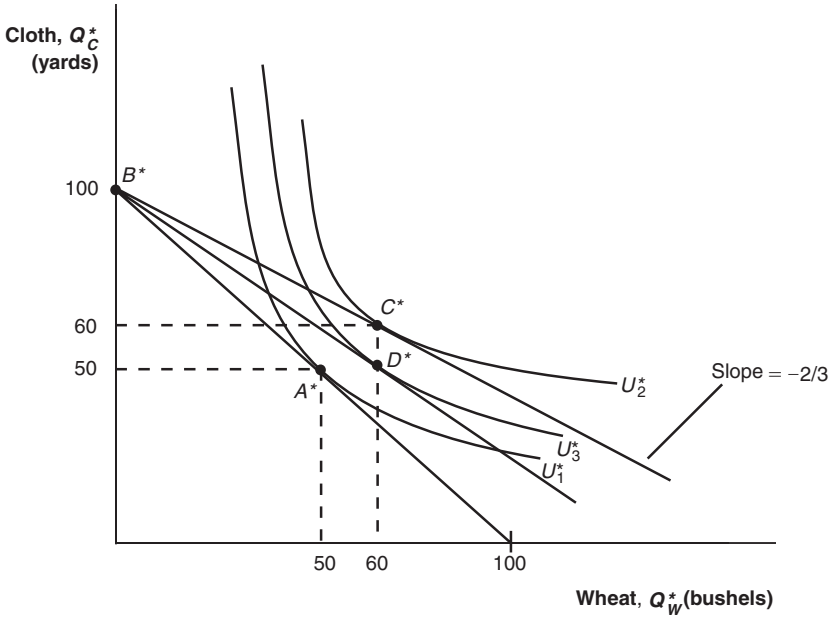
If instead, the technological progress is in the cloth industry, we would have the opposite results. Home's PPF would shift out in the direction of cloth production and the relative price of wheat would increase.

10. a. Using Figure 2-5, show that an increase in the relative price of wheat from its world relative price of 2/3 will raise Home's utility.



Answer: The increase in the relative price of wheat from its international equilibrium of 2/3 allows Home to consume at a higher utility, such as at point *D*.

b. Using Figure 2-6, show that an increase in the relative price of wheat from its world relative price of 2/3 will lower Foreign's utility. What is Foreign's utility when the world relative price reaches 1, and what happens in Foreign when the world relative price of wheat rises above that level?

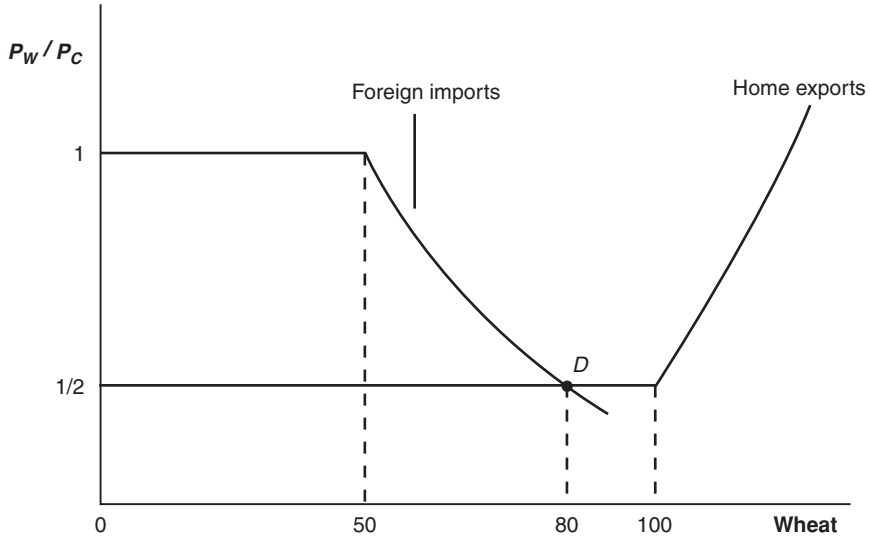


Answer: The increase in the relative price of wheat from its international equilibrium of 2/3 lowers Foreign's utility to U_3^* with consumption at D^*. When the international price reaches 1, it becomes the same as Foreign's no-trade relative price of wheat. Thus, Foreign consumes at point A^*, the no-trade equilibrium. If the international price rises above 1, then it would be greater than Foreign's no-trade relative price of wheat. In this case, Foreign would switch to exporting wheat instead of exporting cloth. The world price line now moves inside the PPF, which will lower the welfare than no trade case.

11. *(This is a harder question.)* Suppose that the Home country is much larger than the Foreign country. For example, suppose we double the number of workers at Home from 25 to 50. Then Home is willing to export up to 100 bushels of wheat at its no-trade price of $P_W/P_C = 1/2$, rather than 50 bushels of wheat as shown in Figure 2-11. In the following, we draw a new version of Figure 2-11, with the larger Home country.

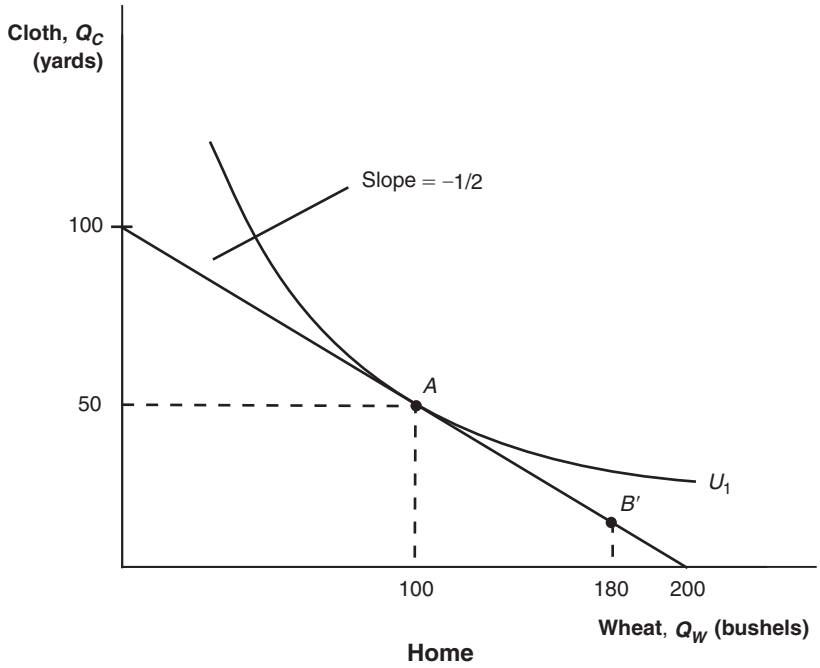
a. From this figure, what is the new world relative price of wheat (at point *D*)?

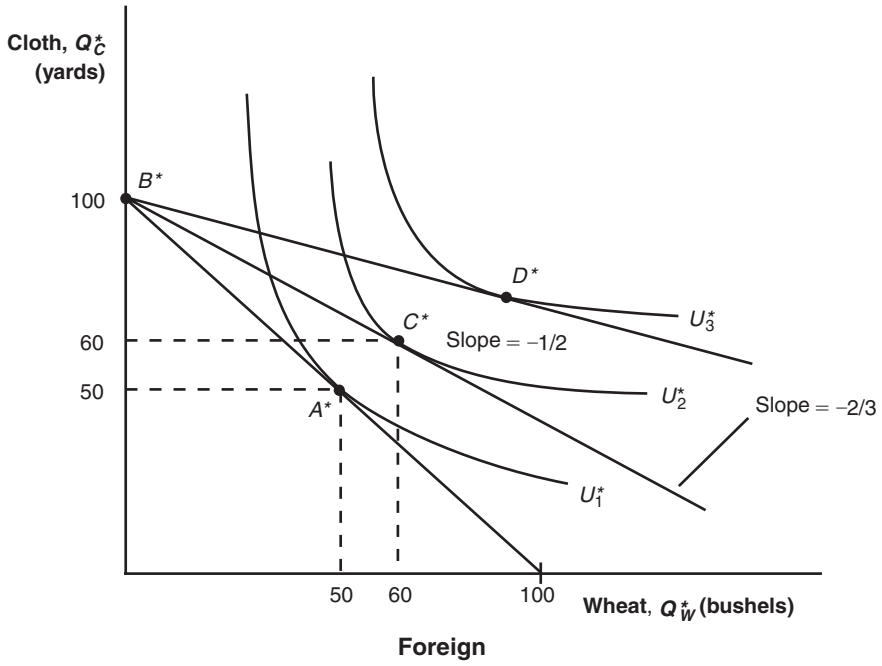
Answer: The intersection of the foreign imports and home exports gives the new international equilibrium relative price of wheat, which is 1/2.



b. Using this new world equilibrium price, draw a new version of the trade equilibrium in Home and in Foreign, and show the production point and consumption point in each country.

Answer: The international price of 1/2 is the same as Home's no-trade relative price of wheat. Home would consume at point *A* and produce at point *B′*. The difference between these two points gives Home exports of wheat of 80 units. (Notice that workers earn equal wages in the two industries, so production can occur anywhere along the PPF.)





Foreign

Because the international price of 1/2 is lower than Foreign's no-trade relative price of wheat, Foreign is able to consume at point D^*, which gives higher gains from trade than at point C^*.

c. Are there gains from trade in both countries? Explain why or why not.

Answer: The foreign country gains a lot from trade, but the home country neither gains nor loses: its consumption point A is exactly the same as what it would be in the absence of trade. This shows that in the Ricardian model, a *small* country can gain the most from trade, whereas a *large* country may not gain (although it will not lose) because the world relative price might equal its own no-trade relative price. So the large country does not see a terms of trade gain (TOT). This special result will not arise in other models that we study, but illustrates how being small can help a country on world markets!

12. Using the results from Problem 11, explain why the Ricardian model predicts that Mexico would gain more than the United States when the two countries signed the North American Free Trade Agreement, establishing free trade between them.

Answer: The Ricardian model predicts that Mexico would gain more than the United States when the two countries join the regional trade agreement because relative to the United States in terms of economic size, Mexico is a small country. For United States, the world price of its exports is similar to the domestic price. Thus, there is not much TOT gain. But for Mexico, the world price is much higher than the domestic price of its exports, so Mexico sees a big TOT improvement.