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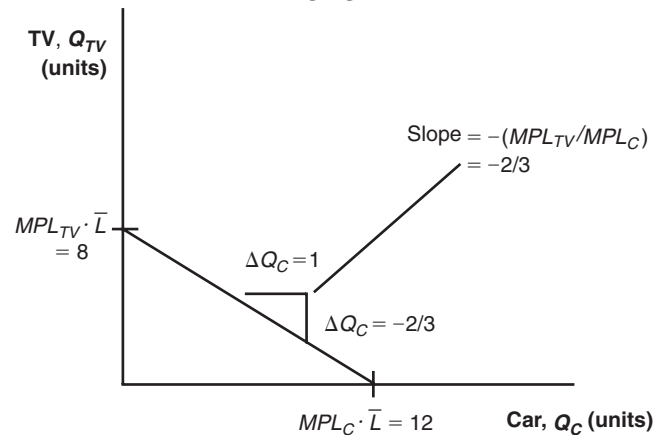
    b. What is the no-trade relative price of cars at Home?

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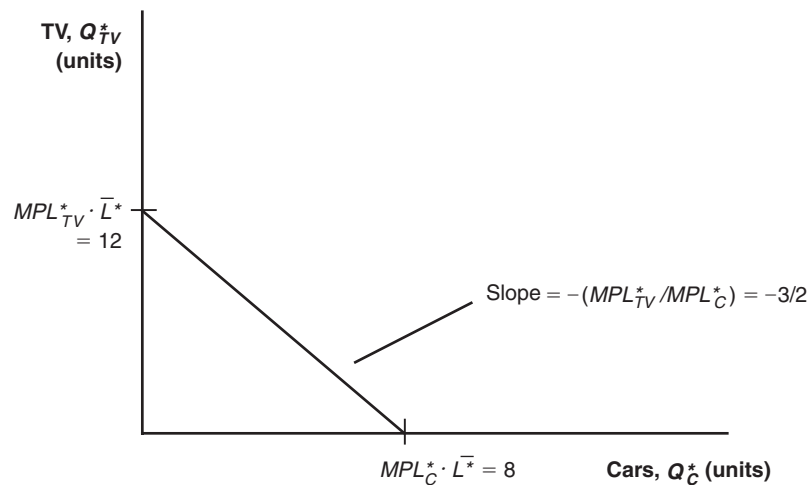
**b.** What is the no-trade relative price of cars in Foreign?

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.
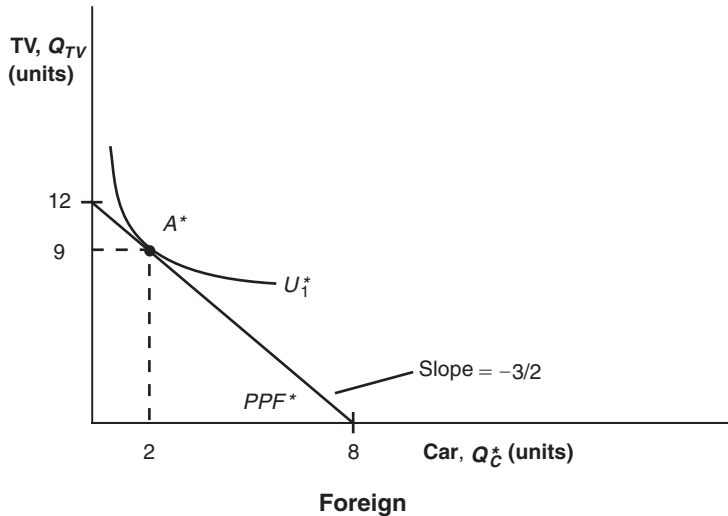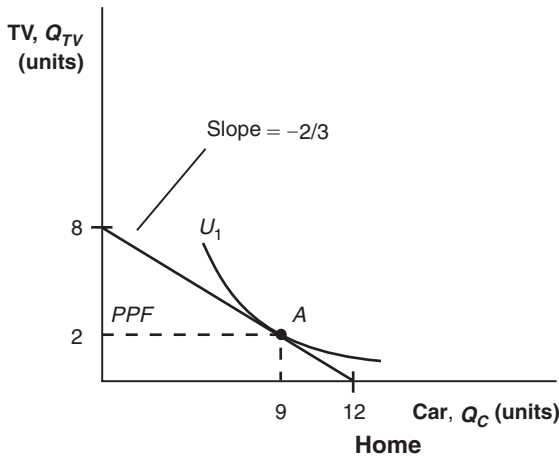
Home

Foreign

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.
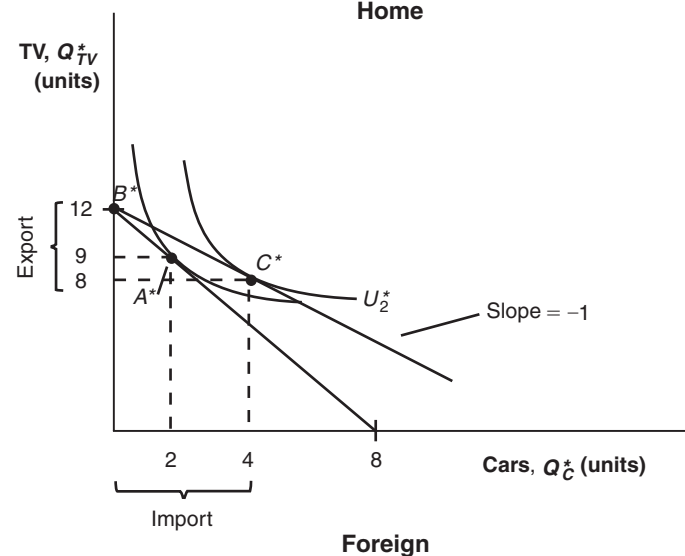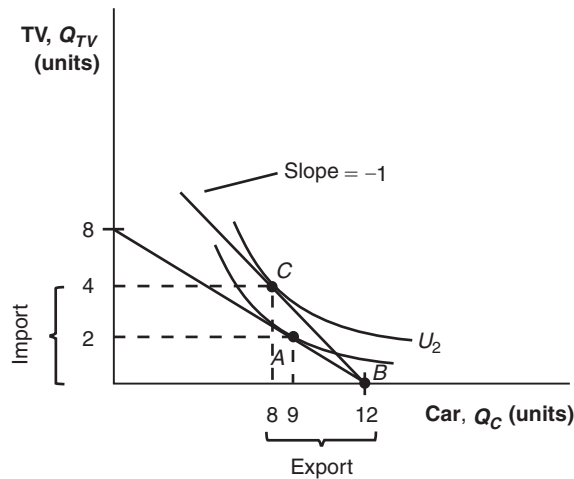
Home

Foreign

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	$\dfrac{MPL_S}{MPL_B} = \dfrac{3}{2}$	$\dfrac{MPL_S^*}{MPL_B^*} = 4$	

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.

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

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

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.

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

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

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?
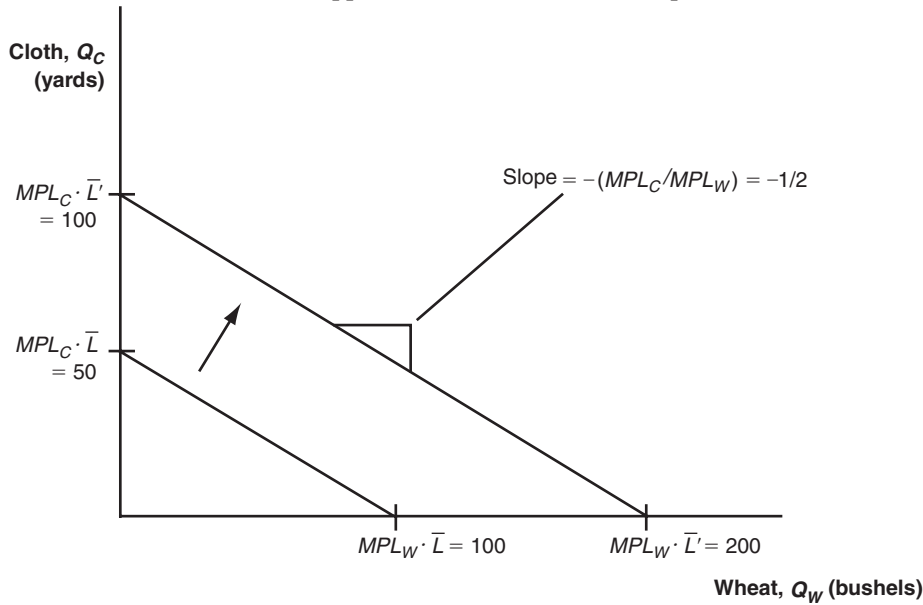
Answer: With the doubling of the number of workers in Home, it can now produce $200 = 4 \cdot 50$ bushels of wheat if it concentrates all resources in the production of wheat, or it could produce $100 = 2 \cdot 50$ yards of cloth by devoting all resources to the production of cloth. The PPF shifts out 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.
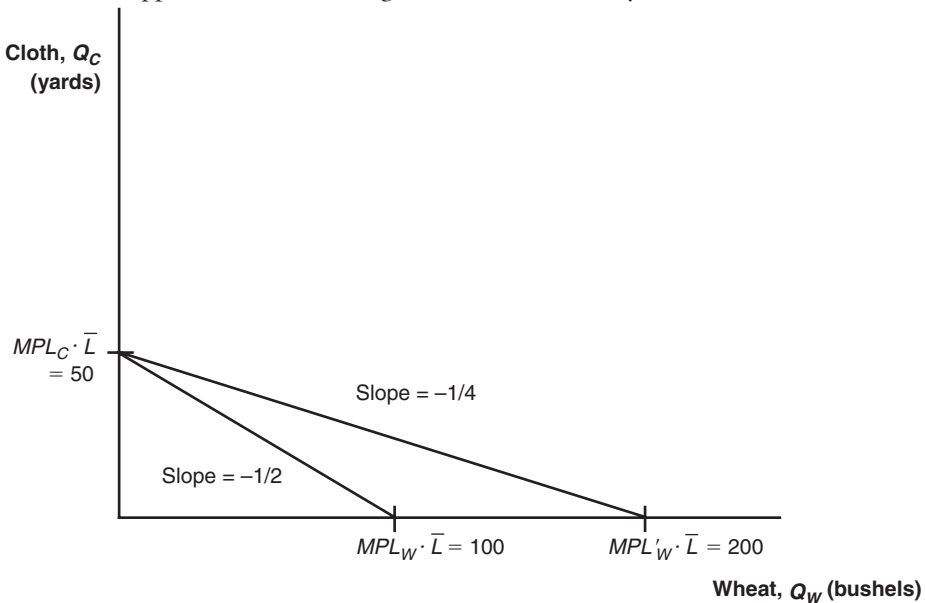
Answer: Because the technological progress is only in the wheat industry, Home's production of cloth remains the same if it devotes all of its resources to producing cloth. If instead Home produces only wheat, it is able to produce more wheat using the same amount of labor. Home's PPF shifts out in the 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.
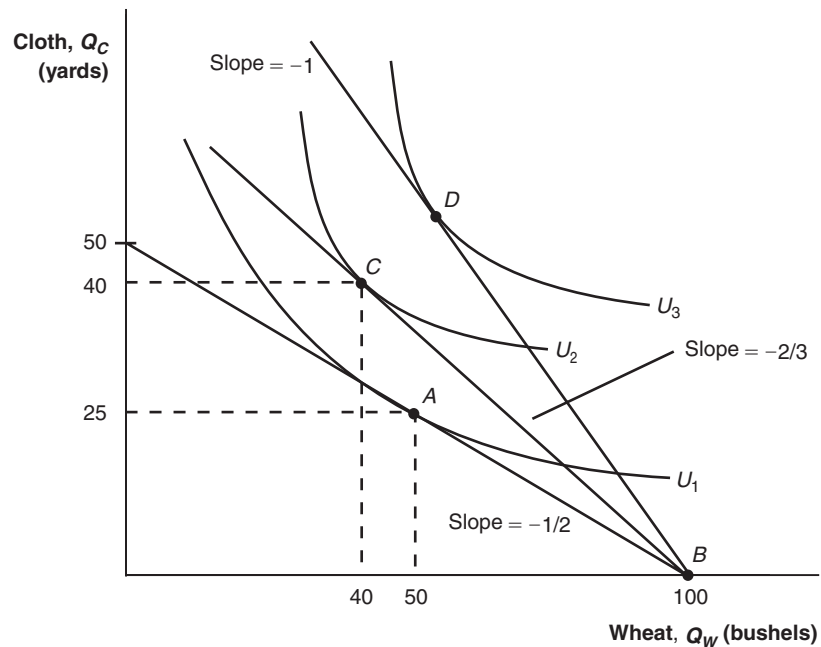
Answer: The increase in the relative price of wheat from its international equilibrium of 2/3 allows Home to consume at a higher utility, such as at point *D*.

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?
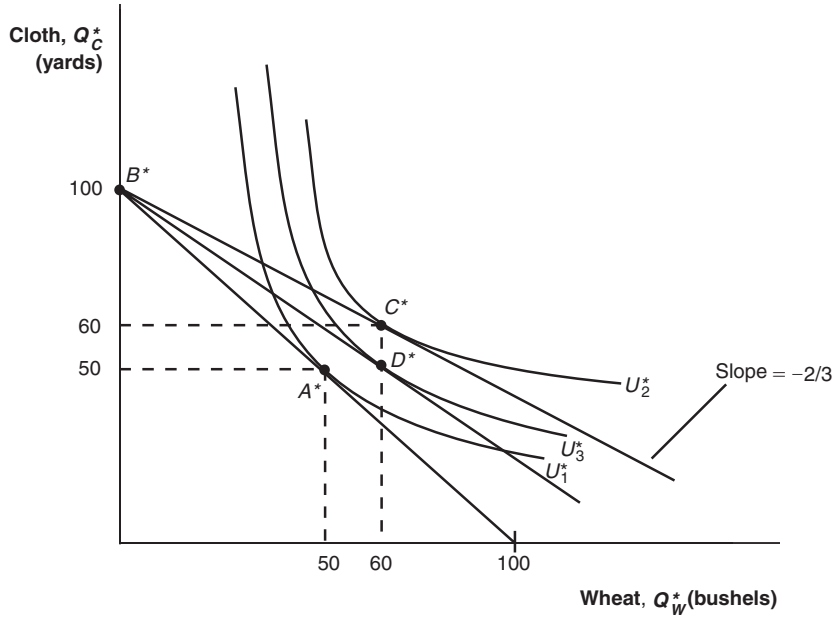
Answer: The increase in the relative price of wheat from its international equilibrium of 2/3 lowers Foreign's utility to U_3^* with consumption at D^*. When the international price reaches 1, it becomes the same as Foreign's no-trade relative price of wheat. Thus, Foreign consumes at point A^*, the 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.
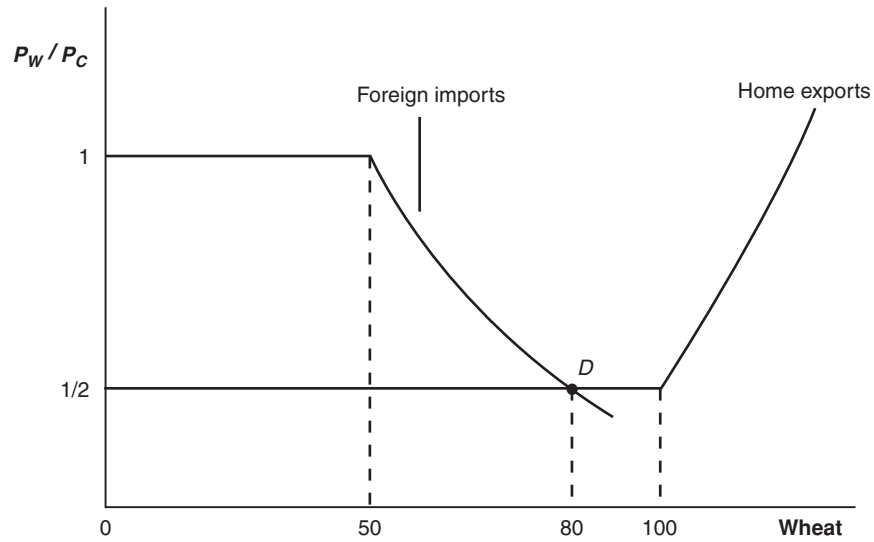
b. Using this new world equilibrium price, draw a new version of the trade equilibrium in Home and in Foreign, and show the production point and consumption point in each country.

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.)

Cloth, Q_C^* (yards)
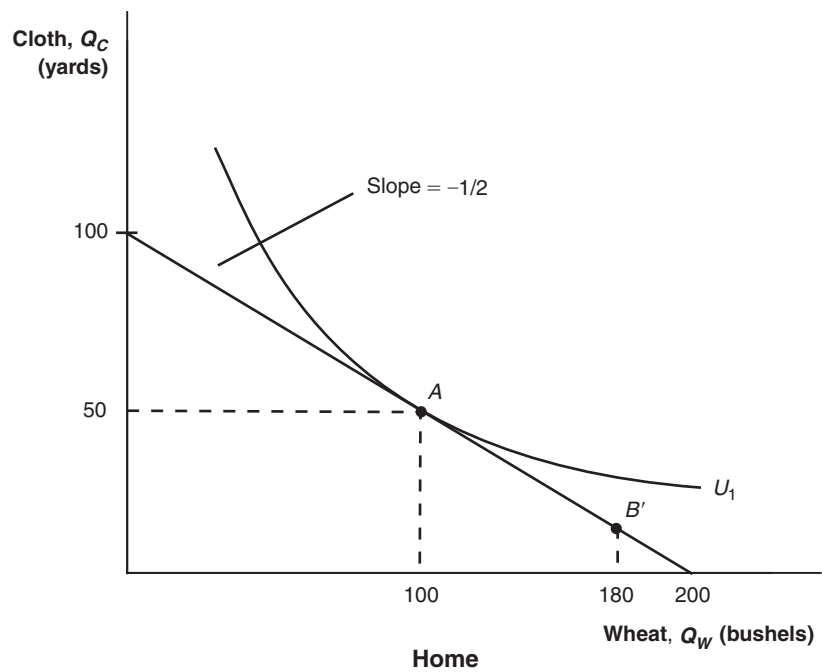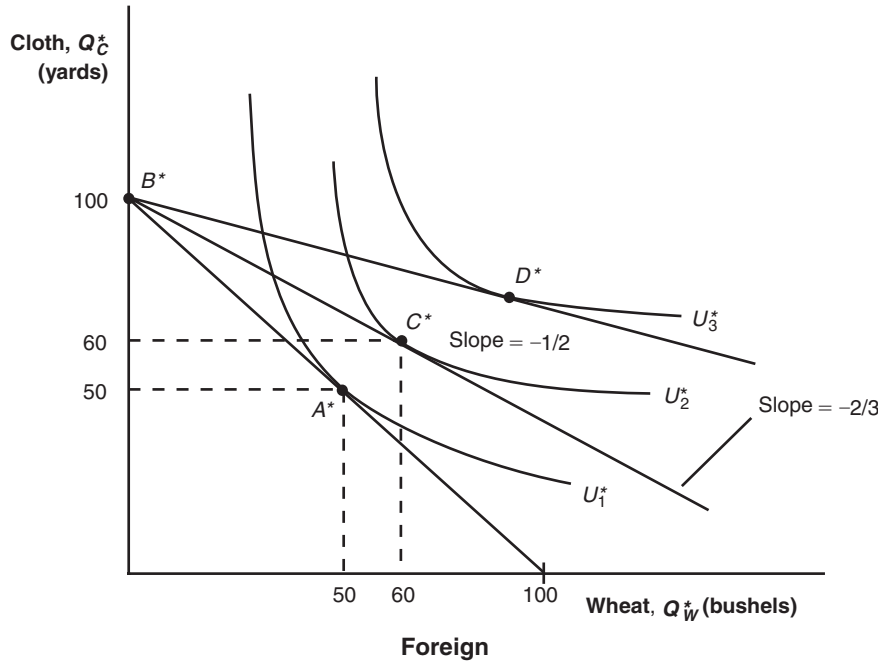
Foreign

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.

Trade and Technology: The Ricardian Model

1. **Reasons for Trade**

2. **Ricardian Model**

3. **Determining the Pattern of International Trade**

4. **Solving for International Prices**

Doug Pensinger/Getty Images

Where did Shaun White's snowboard come from?

In 2005 the United States **imported** (i.e., purchased from other countries) $59 million of snowboards from 20 different countries.

China **exported** (i.e., sold to another country) more than $18 million worth of snowboards to the United States in 2005 and $21 million in 2009.

Introduction

Table 2-1 shows that the U.S. imported 570,000 snowboards from nearly 20 countries in 2012 worth more than $33 million.

This pattern raises the question: with all the manufacturing capability in the United States, why does it purchase snowboards from these countries at all instead of producing them domestically?

TABLE 2-1	U.S. Imports of Snowboards, 2012			
Rank	Country	Value of Imports ($ thousands)	Quantity of Snowboards (thousands)	Average Price ($/board)
1	China	19,560	400.6	49
2	Austria	10,479	93.6	112
3	Taiwan	2,108	46.5	45
4	Canada	362	23.2	16
5	Tunisia	337	2.0	171
6	Spain	285	1.9	151
7	Switzerland	42	0.2	226
8	Netherlands	42	0.3	159
9	Slovenia	27	0.2	121
10	Italy	24	0.2	140
11	Poland	16	0.1	155
12	France	15	0.1	126
13–18	All other countries	46	1.2	40
	Total	33,343	570	58

Introduction

In this chapter we will:

- learn the reasons why countries trade,

- distinguish between **absolute** and **comparative advantage**,

- understand the **Ricardian model**,

- understand the no-trade equilibrium using each country's PPF and **indifference curve**,

- solve for wages across countries,

- solve for **international prices**, and

- derive the home **export supply** and Foreign **import demand curve** and how to arrive at **international trade equilibrium**.

Reasons countries trade goods with each other

- Differences in the **technology** used in each country (i.e., differences in each country's ability to manufacture products)

- Differences in the total amount of **resources** (including labor, capital, and land) found in each country

- Differences in the costs of **offshoring** (i.e., producing the various parts of a good in different countries and then assembling it in a final location)

- The **proximity** of countries to each other (i.e., how close they are to one another)

Introduction

In this chapter, we focus on technology differences across countries as an explanation for trade, called the Ricardian model.

- The Ricardian model explains how the level of a country's technology affects its **trade pattern**.

- It also explains the concept of comparative advantage and why it works as an explanation for trade patterns.

1 Reasons for Trade

Proximity

- The closer countries are the lower the costs of transportation. For example, the largest trading partner of most European countries is another European country.

Resources

- Geography includes the **natural resources**, as well as **labor resources** and **capital**. A country's resources are often collectively called its **factors of production**, the land, labor, and capital used to produce goods and services.

Absolute Advantage

- When a country has the best technology for producing a good, it has an **absolute advantage** in the production of that good.

- Absolute advantage is not a good explanation for trade patterns.

Comparative Advantage

- Instead, **comparative advantage** is the primary explanation for trade among countries.

- A country has comparative advantage in producing those goods that it produces best *compared with* how well it produces other goods.

Comparative Advantage

SIDE BAR

AP Photo/Julie Jacobson

Can Comparative Advantage Be Created? The Case of "Icewine"

- In some cases, a country can export a good without having any advantage in the natural resources needed to produce it.

- One example is "icewine," which is a type of wine invented in Germany but is now also produced in the Niagara Falls region of Canada and the United States.

David Ricardo and Mercantilism

- **Mercantilists** believed that exporting was good because it generated gold and importing was bad because it drained gold from the national treasury.

Bettman/Corbis

- Mercantilists were in favor of high tariffs to ensure high exports and low imports.

- Ricardo showed that countries could benefit from international trade without having to use tariffs.

- Today, many of the worlds major international institutions were founded at least in part on the idea that free trade between countries brings gains for all trading partners.

2 Ricardian Model

The Home Country

To develop a Ricardian model of trade, we will use an example with two goods:

- Wheat and other grains are major exports of the U.S. and Europe.

- Many types of cloth are imported into these countries.

For simplicity, we ignore the role of land and capital and suppose that both goods are produced with labor alone.

The Home Country

We assume that labor is the only resource used to produce goods. The **marginal product of labor (MPL)** is the extra output obtained by using one more unit of labor.

- In Home, one worker produces 4 bushels of wheat, so $MPL_W = 4$.

- Alternatively, one worker can produce 2 yards of cloth, so $MPL_C = 2$.

The Home Country

Home Production Possibilities Frontier

- We can graph Home's **production possibilities frontier** (PPF) using the marginal products for wheat and cloth.

- The slope of the PPF is also the **opportunity cost** of wheat, the amount of cloth that must be given up to obtain one more unit of wheat.

- If Home had 25 workers and all were employed in wheat, Home could produce 100 bushels. If all were employed in cloth they could produce 50 yards.

The Home Country

Home Production Possibilities Frontier

FIGURE 2-1
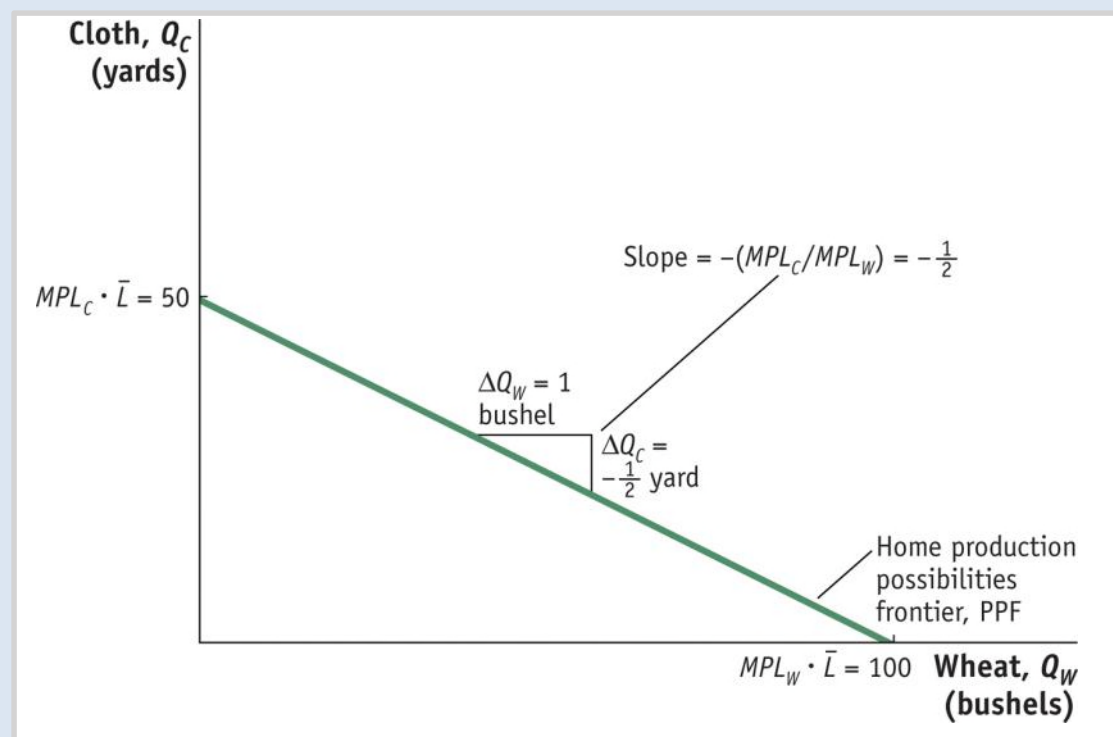
The Home PPF is a straight line between 50 yards of cloth and 100 bushels of wheat.

The slope of the PPF equals the negative of the opportunity cost of wheat. Equivalently, the magnitude of the slope can be expressed as the ratio of the marginal products of labor for the two goods.

$$\text{Slope of PPF} = -\frac{50}{100} = -\frac{MPL_C \cdot \overline{L}}{MPL_W \cdot \overline{L}} = -\frac{MPL_C}{MPL_W} = -\frac{1}{2}$$

The Home Country

Home Indifference Curve

We will represent demand in the Home economy using indifference curves which have the following properties:

- All points on an indifference curve have the same level of **utility**.

- Points on higher indifference curves have higher utility.

- Each indifference curve shows the combinations of two goods, such as wheat and cloth, that a person or economy can consume and be equally satisfied.

Home Indifference Curve

FIGURE 2-2	Home Equilibrium with No Trade
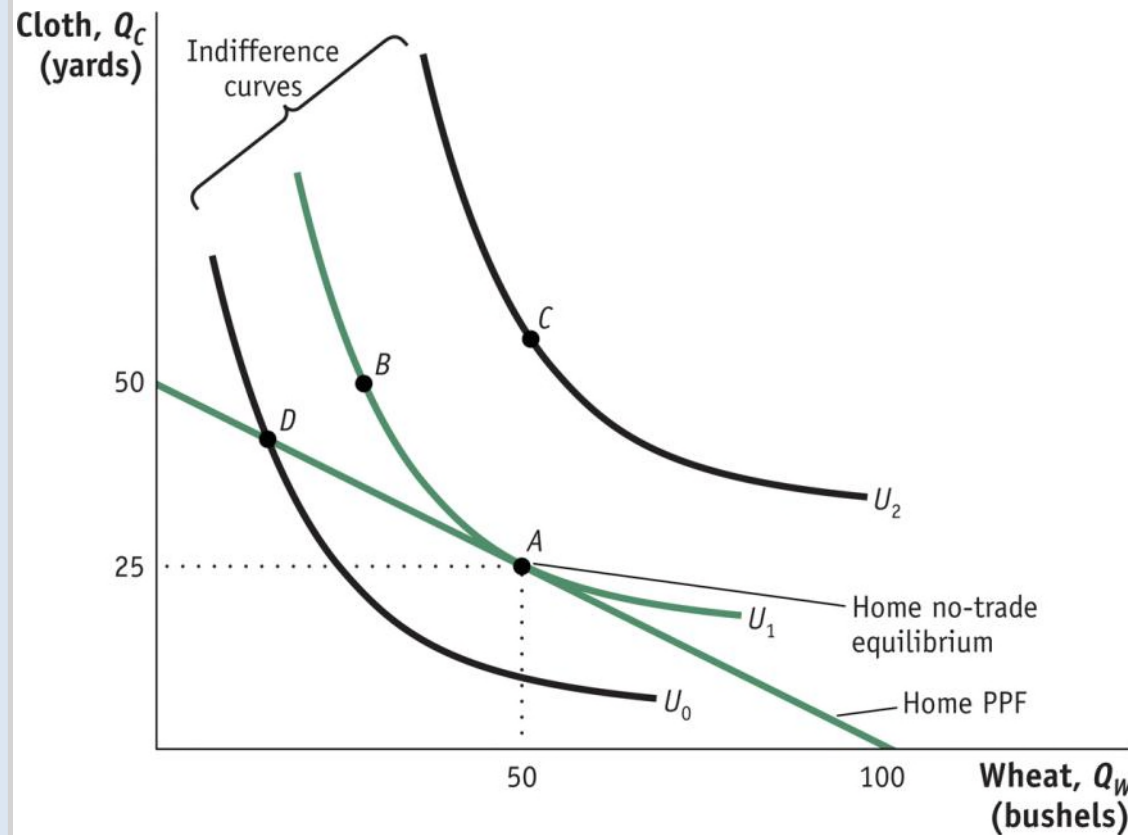
Points *A* and *B* lie on the same indifference curve and give the Home consumers the level of utility U_1.

The highest level of Home utility on the PPF is obtained at point *A*, which is the no-trade equilibrium.

Point *D* is also on the PPF but would give lower utility.

Point *C* represents a higher utility level but is off of the PPF, so it is not attainable in the absence of international trade.

The Home Country

Opportunity Cost and Prices

- The slope of the PPF reflects the opportunity cost of producing one more bushel of wheat.

- Under perfect competition the opportunity cost of wheat should also equal the **relative price** of wheat.

- *Price reflects the opportunity cost of a good.*

The Home Country

Wages

- In competitive markets firms hire workers up to the point at which the hourly wage equals the value of one more hour of production.

- The value of one more hour of labor equals the amount of goods produced in that hour (MPL) times the price of the good.

- Labor will be hired up to the point where wage equals $P \cdot MPL$ for each industry.

The Home Country

Wages

- Use the equality of the wage across industries to obtain the following equation:

$$P_W \bullet MPL_W = P_C \bullet MPL_C$$

- Rearranging terms, we see that

$$P_W/P_C = MPL_C/MPL_W$$

- The right-hand side of the equation is the slope of the production possibilities frontier (the opportunity cost of one more bushel of wheat).

- The left-hand side of the equation is the relative price of wheat.

The Foreign Country

- Assume a Foreign worker can produce one bushel of wheat or one yard of cloth.

$$MPL^*_W = 1, \ MPL^*_C = 1$$

- Assume there are 100 workers available in Foreign.

- If all workers were employed in wheat they could produce 100 bushels.

- If all workers were employed in cloth they could produce 100 yards.

The Foreign Country

Foreign Production Possibilities Frontier

FIGURE 2-3
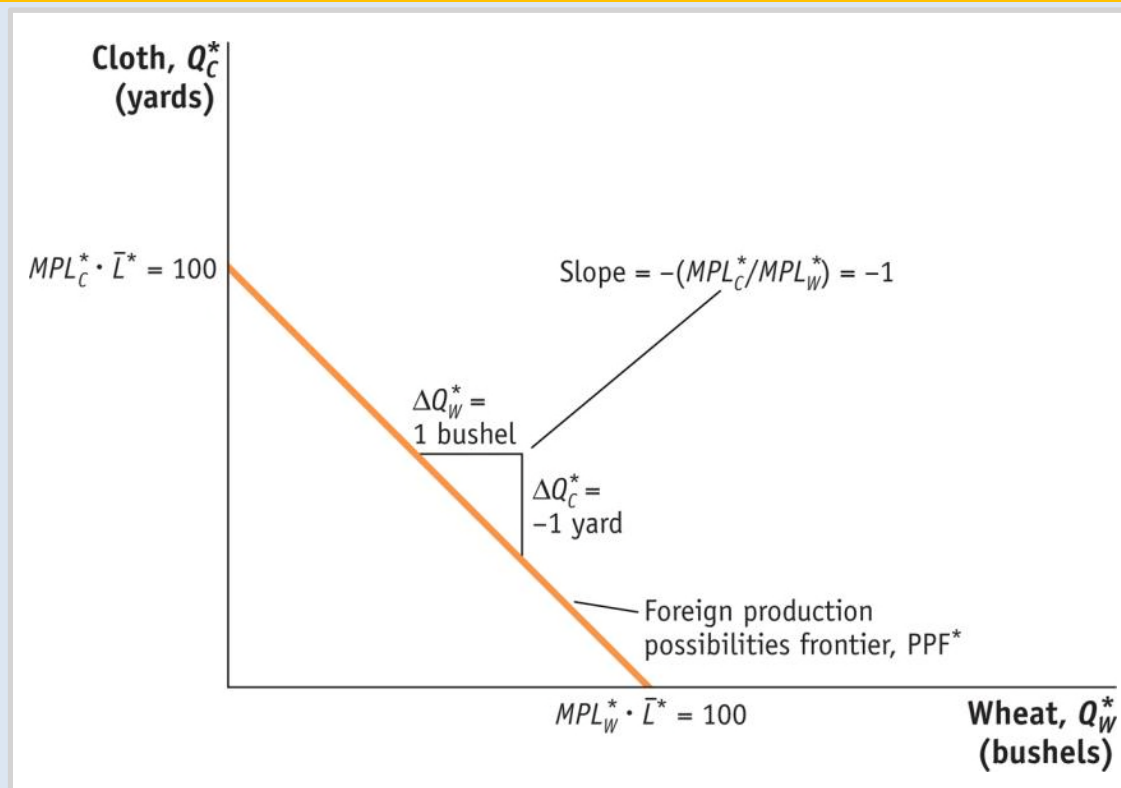
The Foreign PPF is a straight line between 100 yards of cloth and 100 bushels of wheat.

The slope of the PPF equals the negative of the opportunity cost of wheat.

The opportunity cost is the amount of cloth that must be given up (1 yard) to obtain 1 more bushel of wheat.

Comparative Advantage

	Cloth (1 Yard)	Wheat (1 Bushel)
Home	2 Bushels of Wheat	½ Yard of Cloth
Foreign	1 Bushel of Wheat	1 Yard of Cloth

- A country has a comparative advantage in a good when it has a lower opportunity cost of producing than another country.

- By looking at the chart we can see that Foreign has a comparative advantage in producing cloth. Home has a comparative advantage in producing wheat.

2 Ricardian Model

The Foreign Country

Comparative Advantage

FIGURE 2-4   Foreign Equilibrium with No Trade
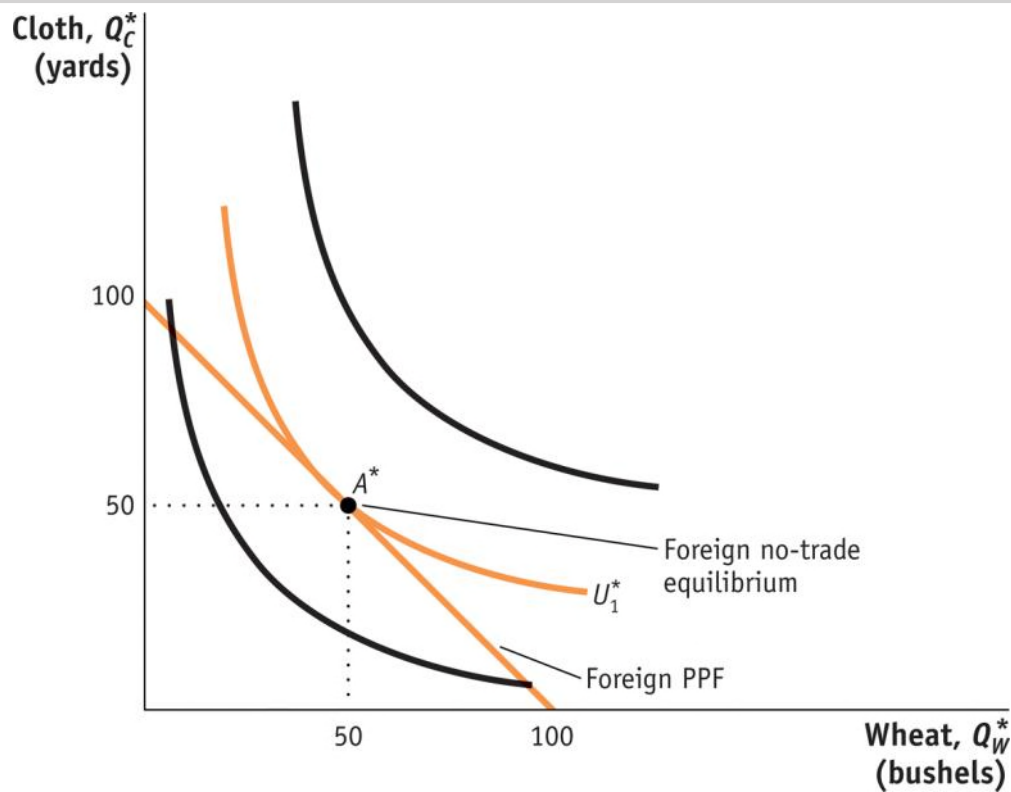
The highest level of Foreign utility on the PPF is obtained at point A^*, which is the no-trade equilibrium.

APPLICATION

Comparative Advantage in Apparel, Textiles, and Wheat

| TABLE 2-2 | Apparel, Textiles, and Wheat in the United States and China |

This table presents sales per employee for the apparel and textile industries in the United States and China, as well as bushels per hour in producing wheat. The United States has an absolute advantage in all of these products, but it has a comparative advantage in producing wheat.

	United States	China	Absolute Advantage
	Sales/Employee	*Sales/Employee*	*U.S./China Ratio*
Apparel	$56,000	$23,000	2.4
Textiles	$165,000	$27,000	6.1
	Bushels/Worker	*Bushels/Worker*	*U.S./China Ratio*
Wheat	12,260	300	41
Comparative Advantage			
Wheat/apparel ratio	0.22	0.01	
Wheat/textile ratio	0.07	0.01	

International Trade Equilibrium

What happens when goods are traded between Home and Foreign? We will see:

- that a country's no-trade relative price determines which product it will export and which it will import.

- the no-trade relative price equals its opportunity cost of production.

- the pattern of exports and imports will be determined by the opportunity costs of production in each country—*their comparative advantage*.

International Trade Equilibrium

Examining each country's no-trade relative price we can determine which product it will export and which it will import.

- The relative price of cloth in Foreign is $P_C/P_W = 1$.

- The relative price of cloth in Home is $P_C/P_W = 2$.

- Therefore, Foreign would want to export cloth to Home— they can make it for \$1 and export it for more than \$1.

- Home will export wheat and Foreign will export cloth.

Both countries export the good for which they have the comparative advantage.

International Trade Equilibrium

The two countries are in an international trade equilibrium when the relative price of wheat is the same in the two countries.

To fully understand the international trade equilibrium, we are interested in two issues:

- Determining the relative price of wheat (or cloth) in the trade equilibrium

- Seeing how the shift from the no-trade equilibrium to the trade equilibrium affects production and consumption in both Home and Foreign.

International Trade Equilibrium

- The relative price of wheat in the trade equilibrium will be between the no-trade price in the two countries.

- For now assume the free-trade price of P_W/P_C is 2/3 (between the price of ½ in Home and 1 in Foreign).

- We can now take this price and see how trade changes production and consumption in each country.

- The **world price line** shows the range of *consumption possibilities* that a country can achieve by specializing in one good and engaging in international trade.

International Trade Equilibrium

Change in Production and Consumption

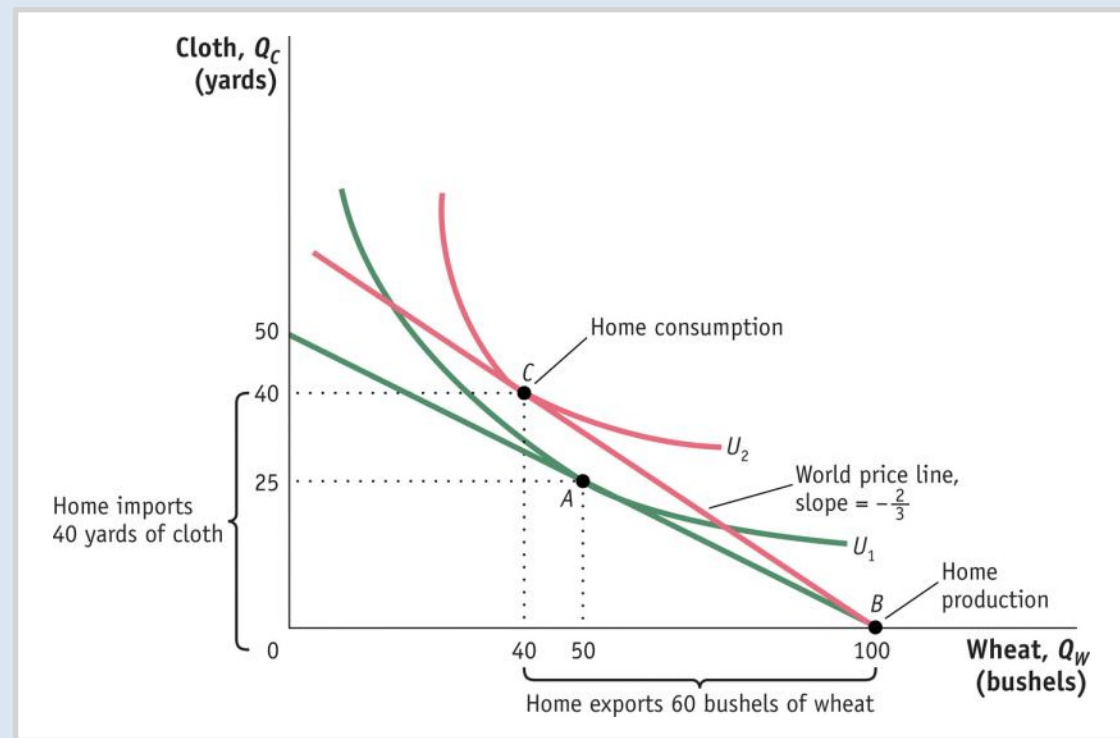| FIGURE 2-5 (1 of 3)	Home Equilibrium with Trade
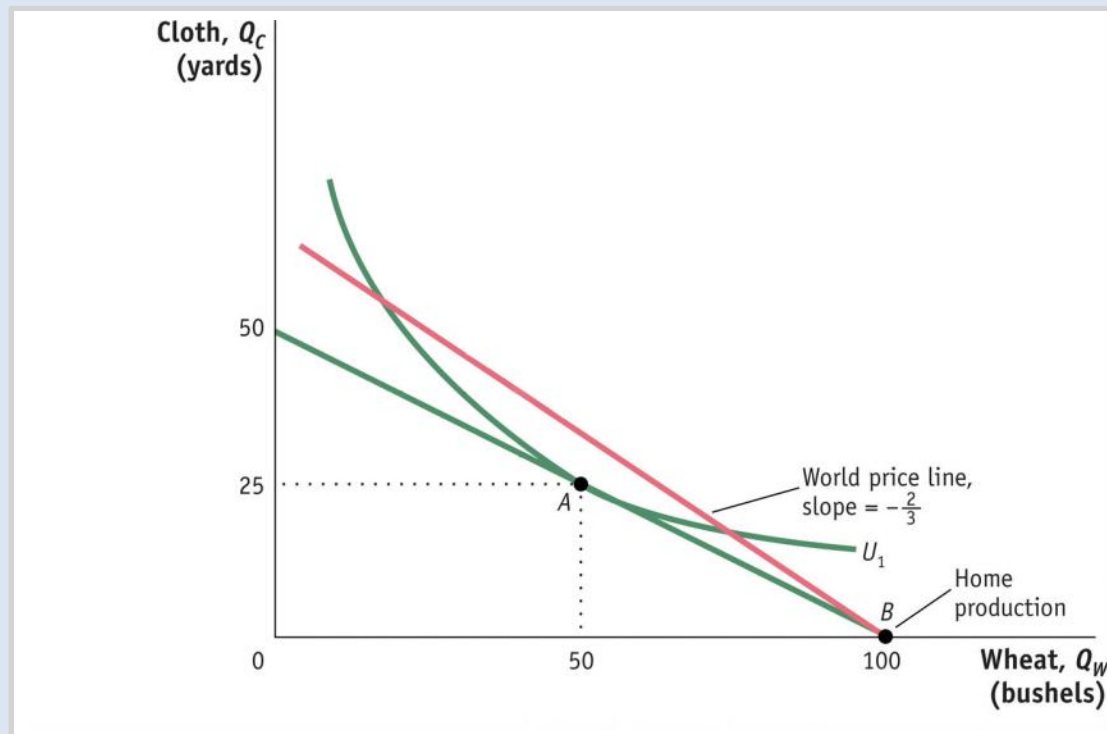
With a world relative price of wheat of $^2/_3$, Home production will occur at point *B*.

Through international trade, Home is able to export each bushel of wheat it produces in exchange for $^2/_3$ yard of cloth.

International Trade Equilibrium

Change in Production and Consumption

FIGURE 2-5 (2 of 3)	Home Equilibrium with Trade (continued)
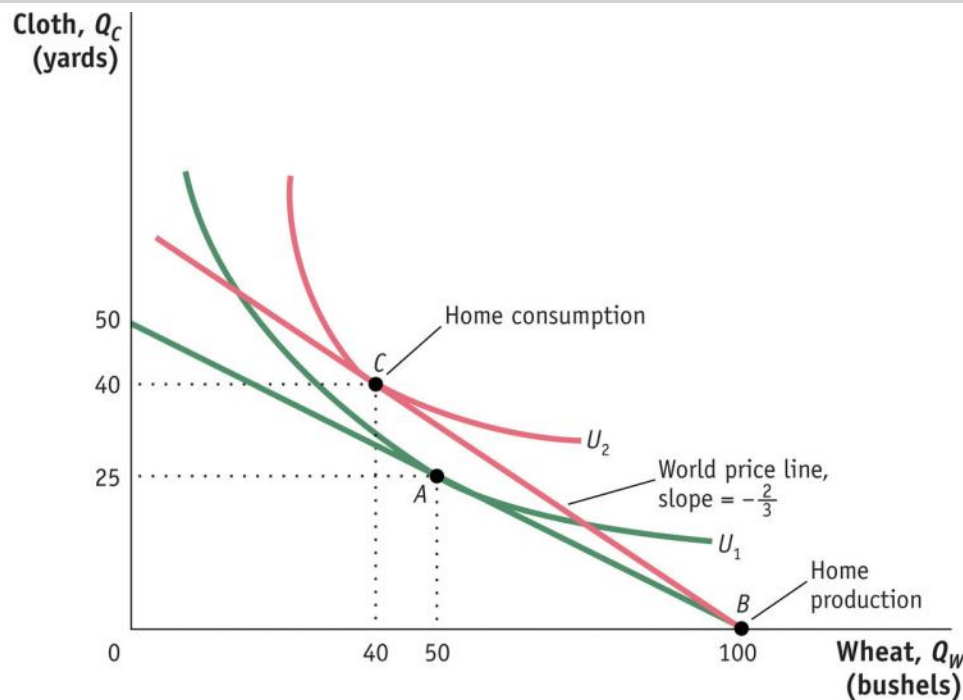
As wheat is exported, Home moves up the world price line BC. Home consumption occurs at point C, at the tangent intersection with indifference curve U_2, since this is the highest possible utility curve on the world price line.

International Trade Equilibrium

Change in Production and Consumption

| FIGURE 2-5 (3 of 3) | Home Equilibrium with Trade (continued) |
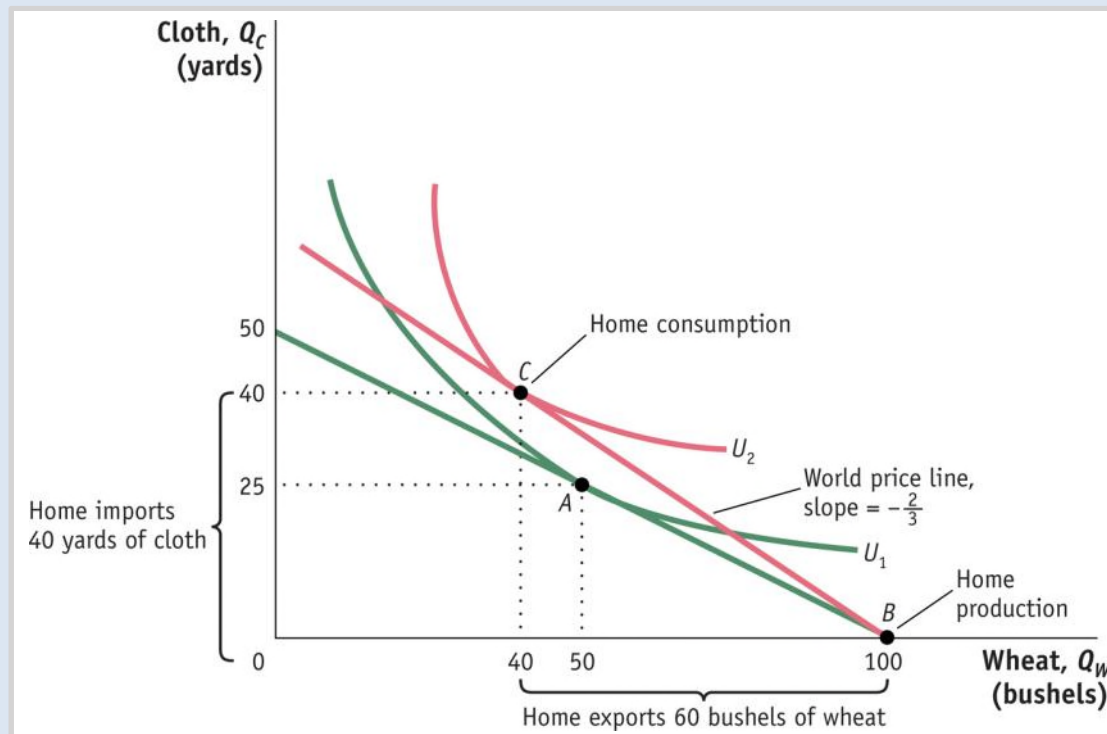
Given these levels of production and consumption, we can see that total exports are 60 bushels of wheat in exchange for imports of 40 yards of cloth and also that Home consumes 10 fewer bushels of wheat and 15 more yards of cloth relative to its pre-trade levels.

International Trade Equilibrium

FIGURE 2-5 (revisited)   Home Equilibrium with Trade

International Trade

Home obtains a higher utility with international trade than in the absence of trade (U_2 is higher than U_1).

The finding that Home's utility increases with trade is our first demonstration of the **gains from trade**.

International Trade Equilibrium

Pattern of Trade and Gains from Trade

FIGURE 2-6 (1 of 2)	Foreign Equilibrium with Trade
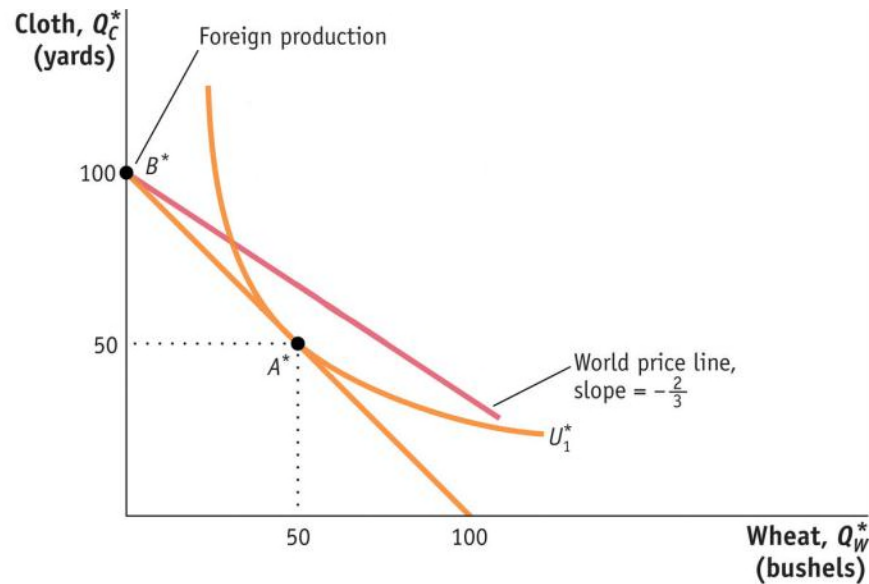
With a world relative price of wheat of $2/3$, Foreign production will occur at point B^*.

Through international trade, Foreign is able to export $2/3$ yard of cloth in exchange for 1 bushel of wheat, moving down the world price line.

International Trade Equilibrium

Pattern of Trade and Gains from Trade

| FIGURE 2-6 (2 of 2) | Foreign Equilibrium with Trade (continued) |
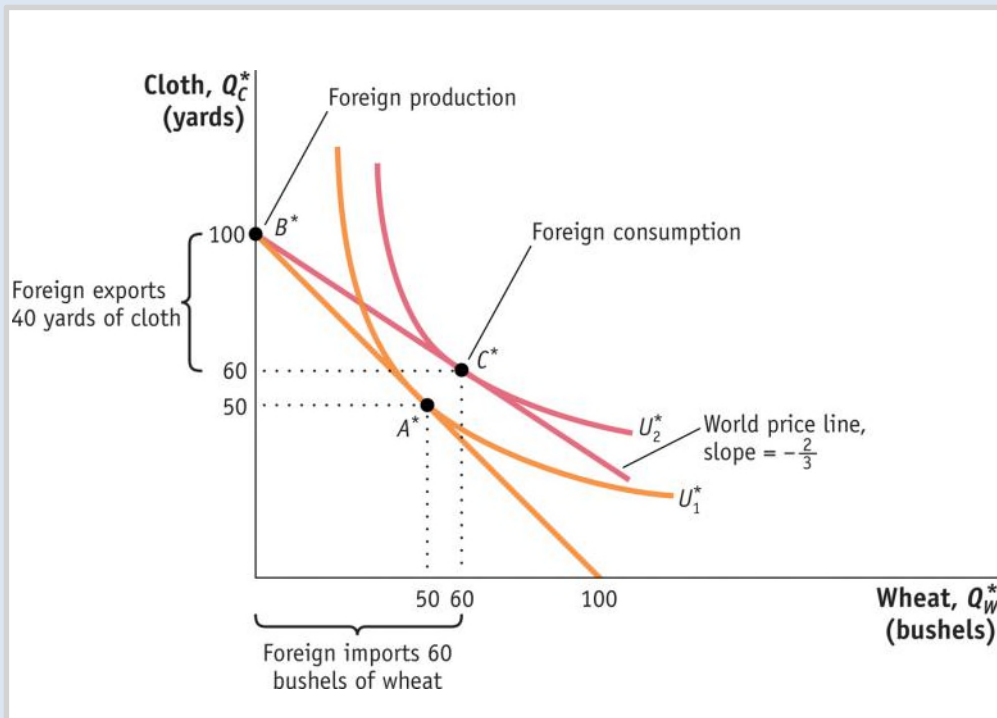
Foreign consumption occurs at point C^*, and total exports are 40 yards of cloth in exchange for imports of 60 bushels of wheat. Relative to its pre-trade wheat and cloth consumption (point A^*), Foreign consumes 10 more bushels of wheat and 10 more yards of cloth.

Pattern of Trade and Gains from Trade

Each country is exporting the good for which it has the comparative advantage.

- This confirms that the pattern of trade is determined by comparative advantage.

- This is the first lesson of the Ricardian model.

There are gains from trade for both countries.

- This is the second lesson of the Ricardian model.

Solving for Wages Across Countries

$$\text{Home wage} = \begin{cases} MPL_W = 4 \text{ bushels of wheat} \\ \text{or} \\ (P_W/P_C) \cdot MPL_W = \frac{8}{3} \text{ yard of cloth} \end{cases}$$

$$\text{Foreign wage} = \begin{cases} (P_C^*/P_W^*) \cdot MPL_C^* = \frac{3}{2} \text{ bushels of wheat} \\ \text{or} \\ MPL_C^* = 1 \text{ yard of cloth} \end{cases}$$

Absolute Advantage

As our example shows, wages are determined by absolute advantage. In contrast, the pattern of trade is determined by comparative advantage.

Solving for Wages Across Countries

- In competitive labor markets, firms will pay workers the value of their marginal product.

- Home produces and exports wheat, therefore they will be paid in terms of that good—the real wage is $MPL_W = 4$ bushels of wheat.

- The workers sell the wheat on the world market at a relative price of $P_W/P_C = 2/3$.

- We can use this to calculate the real wage in terms of cloth: $(P_W/P_C)MPL_W = (2/3)4 = 8/3$ yards.

Solving for Wages Across Countries

- We can do this for Foreign as well and summarize:

  Home real wage is:

    - 4 bushels of wheat or 8/3 yards of cloth.

  Foreign real wage is:

    - 3/2 bushels of wheat or 1 yard of cloth.

- Foreign workers earn less than Home workers as measured by their ability to purchase either good.

- This reflects Home's absolute advantage in the production of both goods.
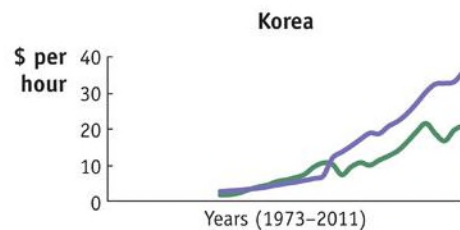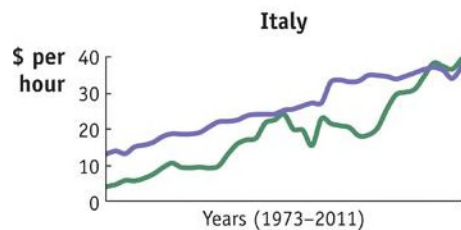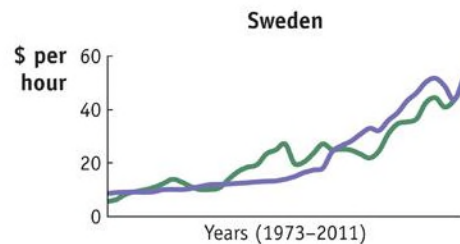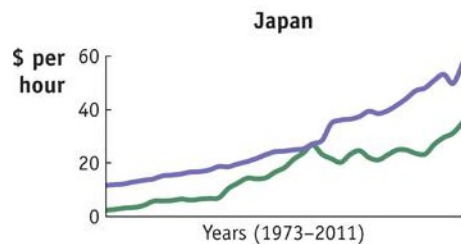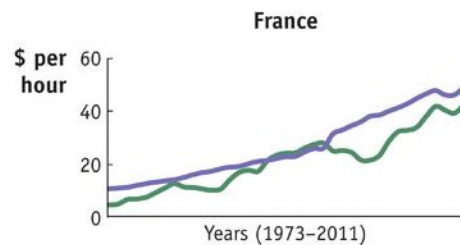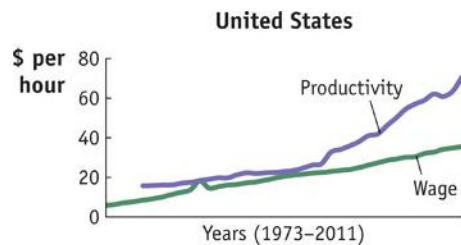
Labor Productivity and Wages
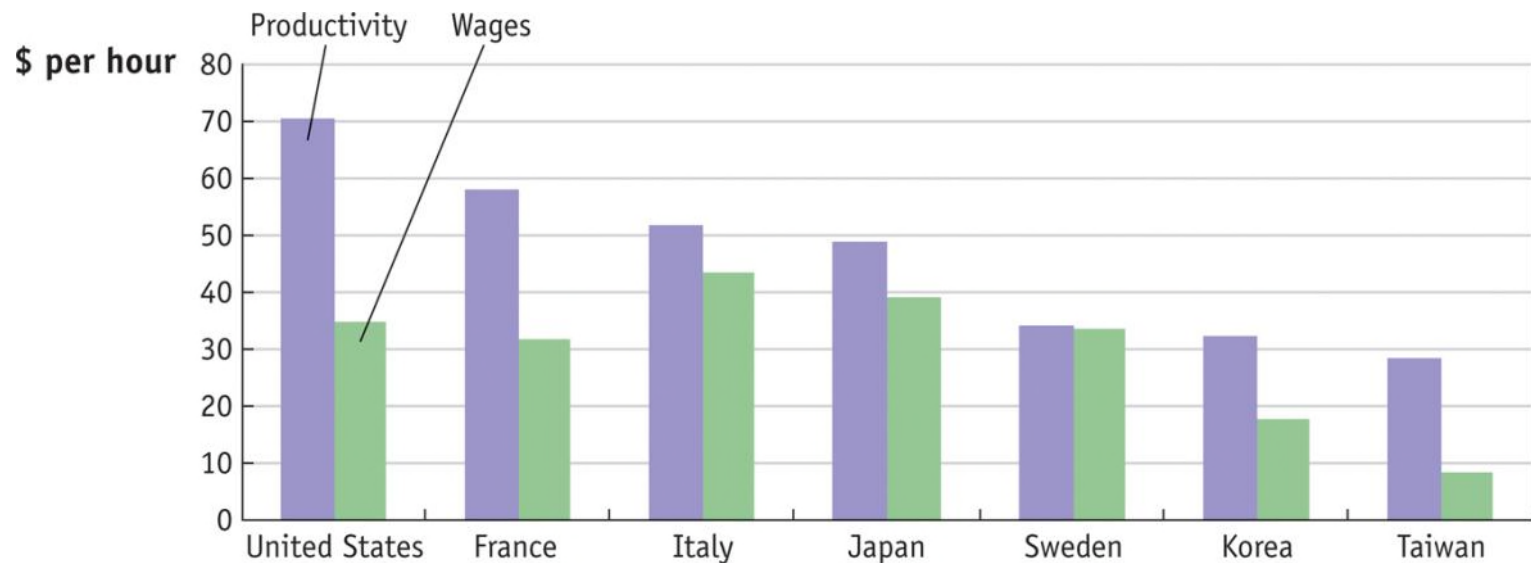
Labor Productivity and Wages, 2010 Labor productivity is measured by value-added per hour of work and can be compared with the wages paid in manufacturing in various countries.
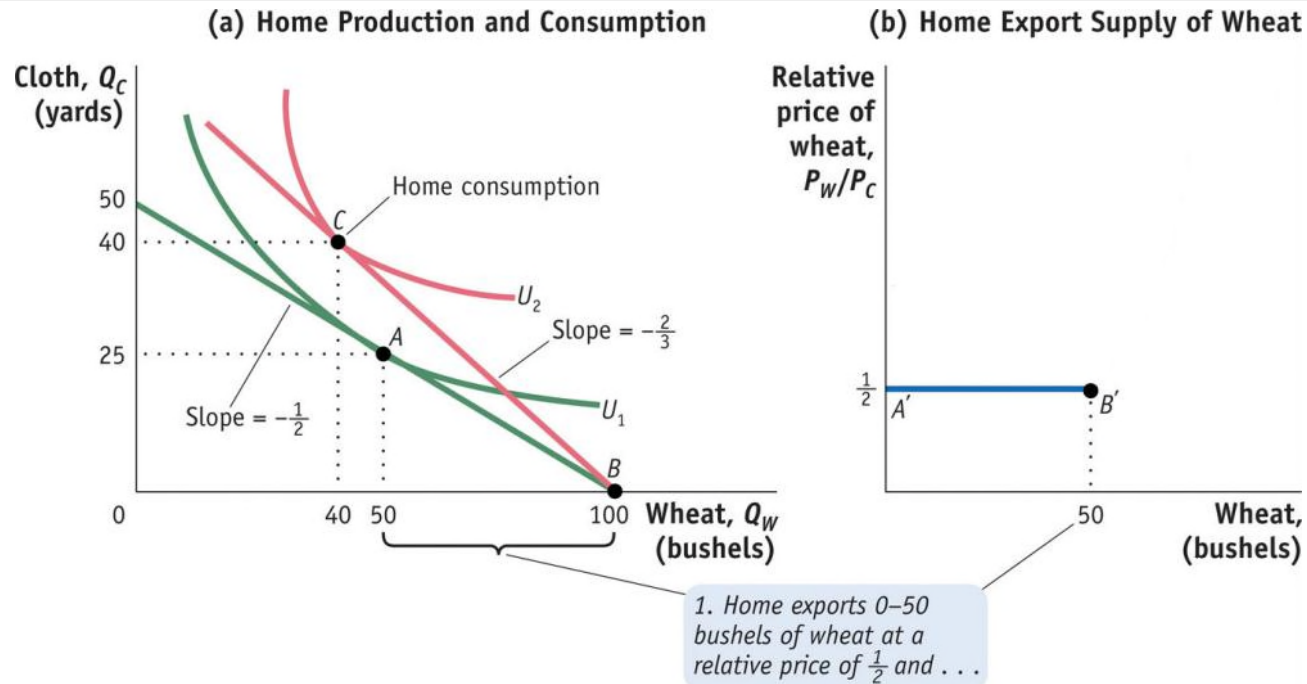
Labor Productivity and Wages

The trends in labor productivity and wages can also be graphed over time.

The general upward movement in labor productivity is matched by upward movements in wages, as predicted by the Ricardian model.

Home Export Supply Curve

FIGURE 2-9 (1 of 2)

(a) Home Production and Consumption
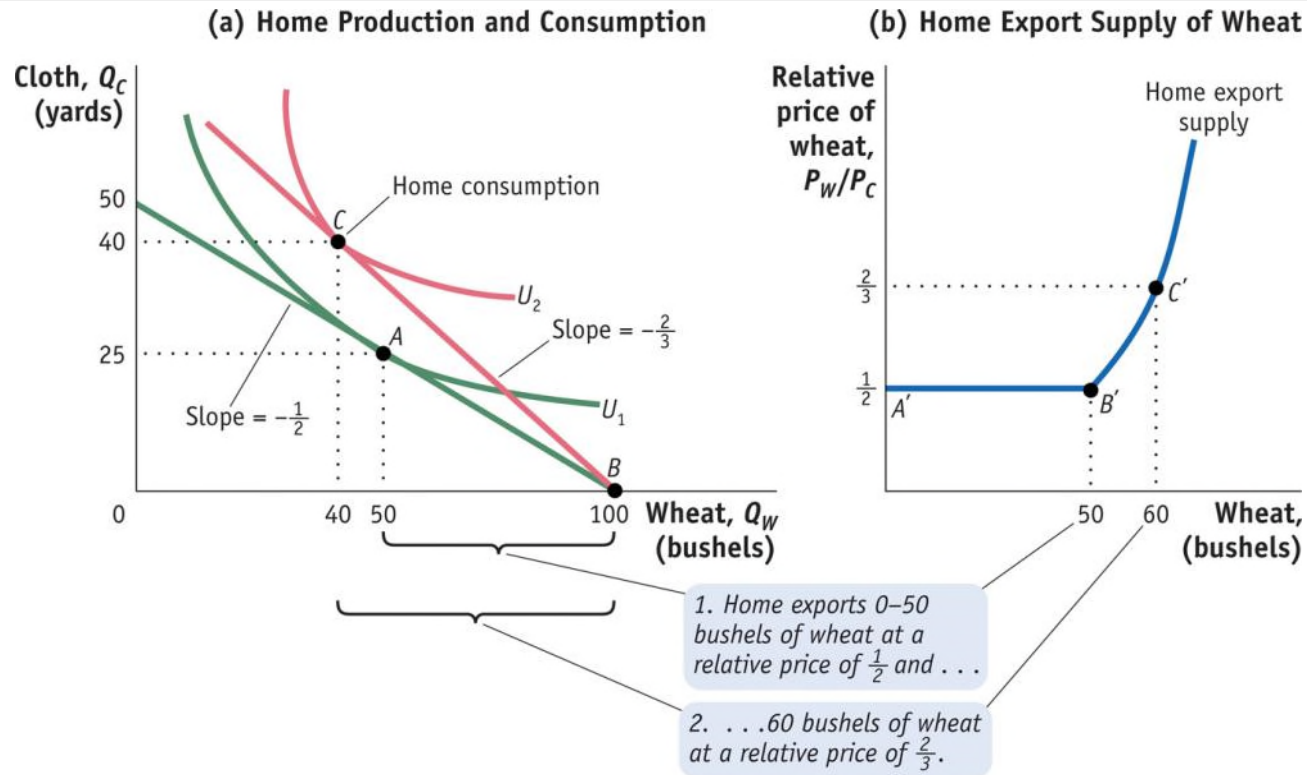
(b) Home Export Supply of Wheat

Home Export Supply Panel (a) repeats Figure 2-5 showing the trade equilibrium for Home with production at point *B* and consumption at point *C*. Panel (b) shows the Home export supply of wheat.

Home Export Supply Curve

FIGURE 2-9 (2 of 2)

(a) Home Production and Consumption

(b) Home Export Supply of Wheat

1. Home exports 0–50 bushels of wheat at a relative price of $\frac{1}{2}$ and . . .

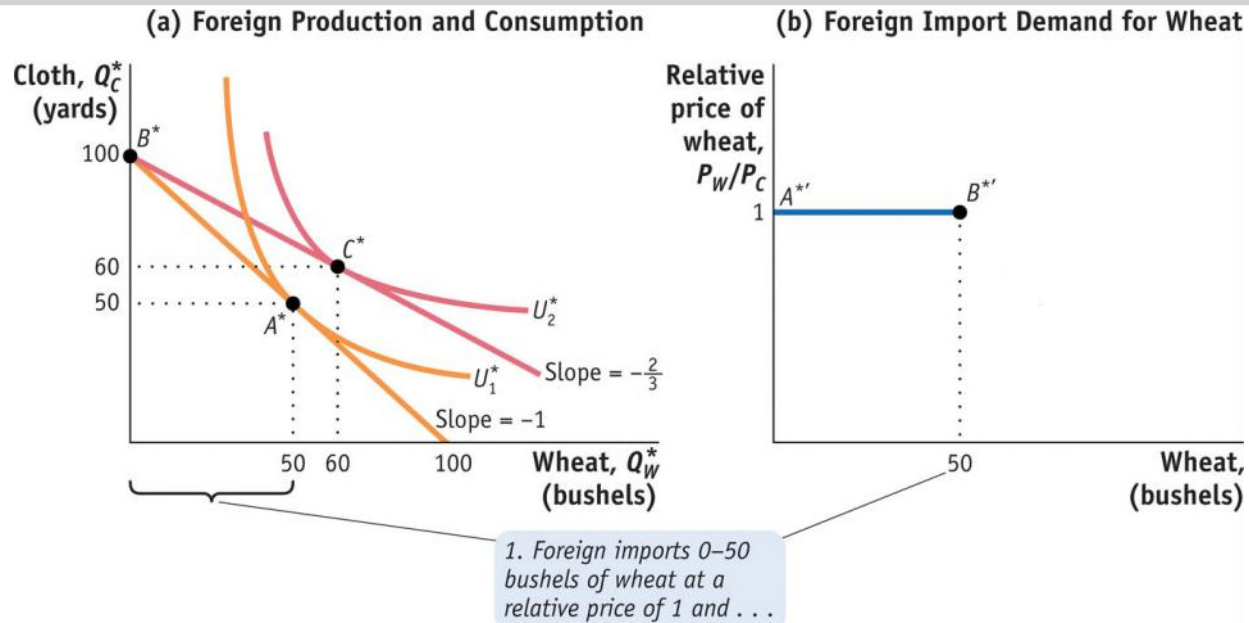2. . . .60 bushels of wheat at a relative price of $\frac{2}{3}$.

Home Export Supply (continued) For relative prices above $\frac{1}{2}$, Home exports more than 50 bushels, along the segment $B'C'$. For example, at the relative price of $\frac{2}{3}$, Home exports 60 bushels of wheat.

Foreign Import Demand Curve

FIGURE 2-10 (1 of 2)

(a) Foreign Production and Consumption

(b) Foreign Import Demand for Wheat

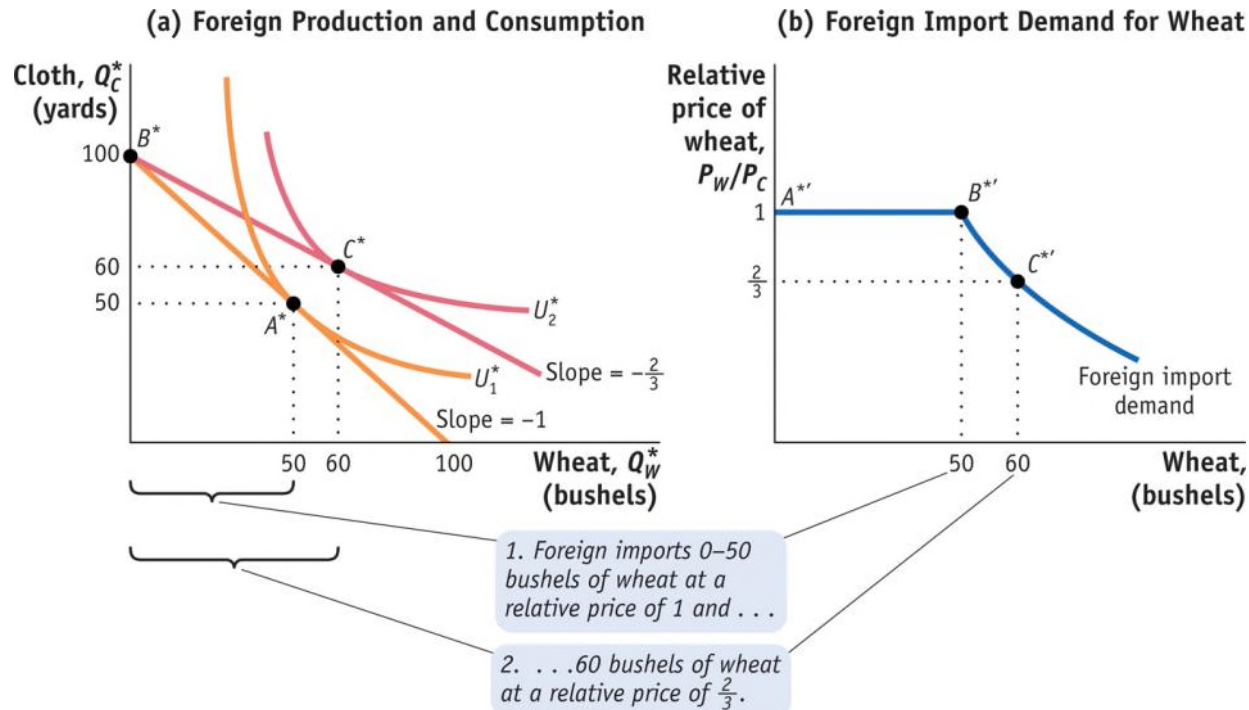1. Foreign imports 0–50 bushels of wheat at a relative price of 1 and . . .

Foreign Import Demand Panel (a) repeats Figure 2-6. Panel (b) shows Foreign import demand for wheat. When the relative price of wheat is 1, Foreign will import any amount of wheat between 0 and 50 bushels, along the segment $A^{*\prime}B^{*\prime}$ of the Foreign import demand curve.

Foreign Import Demand Curve

FIGURE 2-10 (2 of 2)

(a) Foreign Production and Consumption

(b) Foreign Import Demand for Wheat

1. Foreign imports 0–50 bushels of wheat at a relative price of 1 and . . .
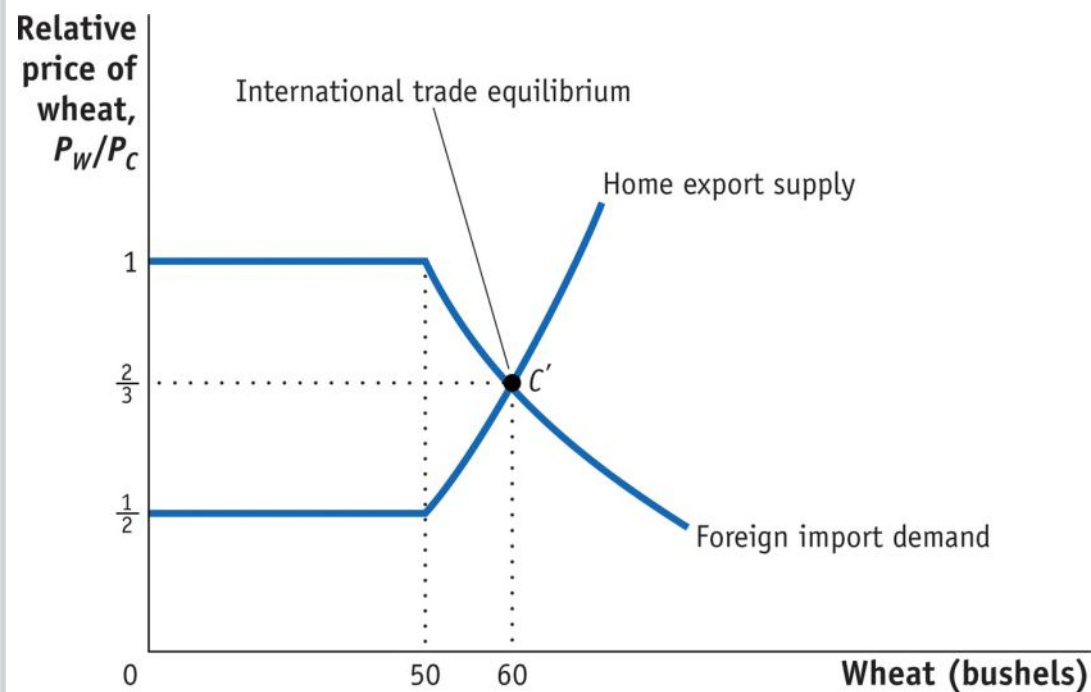
2. . . .60 bushels of wheat at a relative price of $\frac{2}{3}$.

Foreign Import Demand (continued) For relative prices below 1, Foreign imports more than 50 bushels, along the segment $B^{*\prime}C^{*\prime}$. For example, at the relative price of $\frac{2}{3}$, Foreign imports 60 bushels of wheat.

International Trade Equilibrium

FIGURE 2-11

World Market for Wheat Putting together the Home **export supply curve** and the Foreign import demand curve for wheat, the world equilibrium is established at point C', where the relative price of wheat is $2/3$.

International Trade Equilibrium

The Terms of Trade

The price of a country's exports divided by the price of its imports is called the **terms of trade**.

- Because Home exports wheat, (P_W/P_C) is its terms of trade.

- Foreign exports cloth, so (P_W/P_C) is its terms of trade.

- In this case, having a higher price for cloth (Foreign's export) or a lower price for wheat (Foreign's import) would make the Foreign country better off.

The Terms of Trade for Primary Commodities

Economists Raúl Prebisch and Hans Singer argued that the price of primary commodities would decline over time relative to the price of manufactured goods.

Support for Hypothesis

- As people/countries become richer, they spend a smaller share of their income on food.

- For mineral products, industrialized countries continually find substitutes in the production of manufactured products.
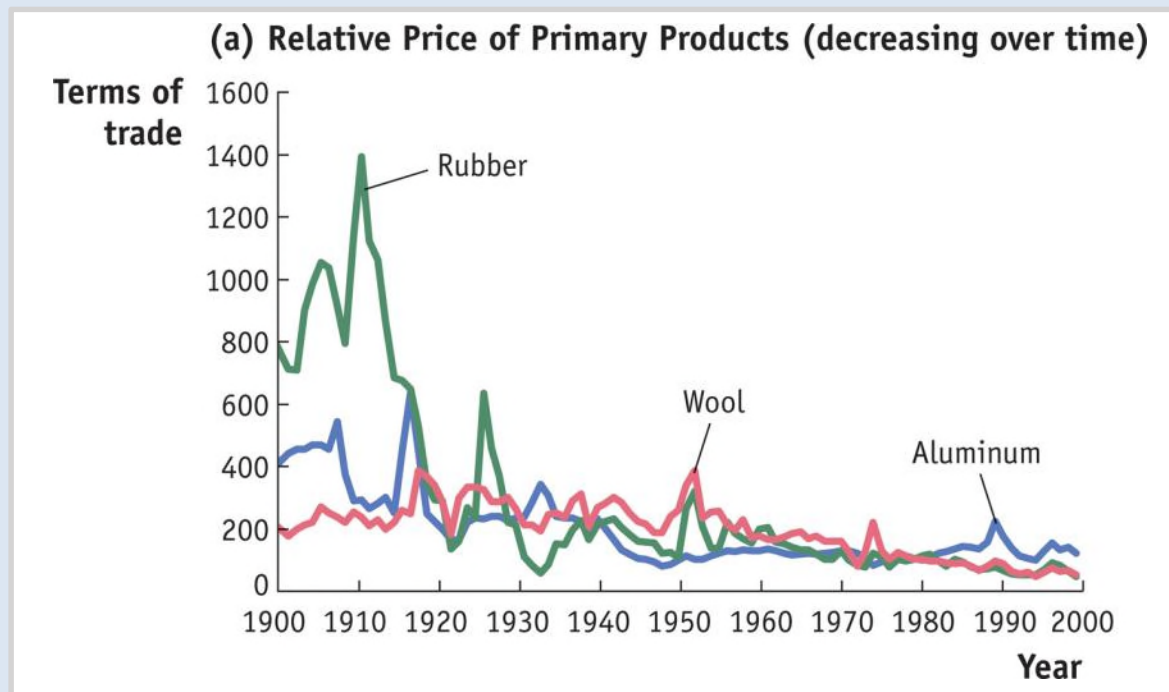
Evidence against Hypothesis

- Technological progress in manufactured goods can certainly lead to a fall in the price of these goods as they become easier to produce.

- At least for oil, the cartel restricting prices has caused an increase in the terms of trade for oil-exporting countries.

APPLICATION

The Terms of Trade for Primary Commodities
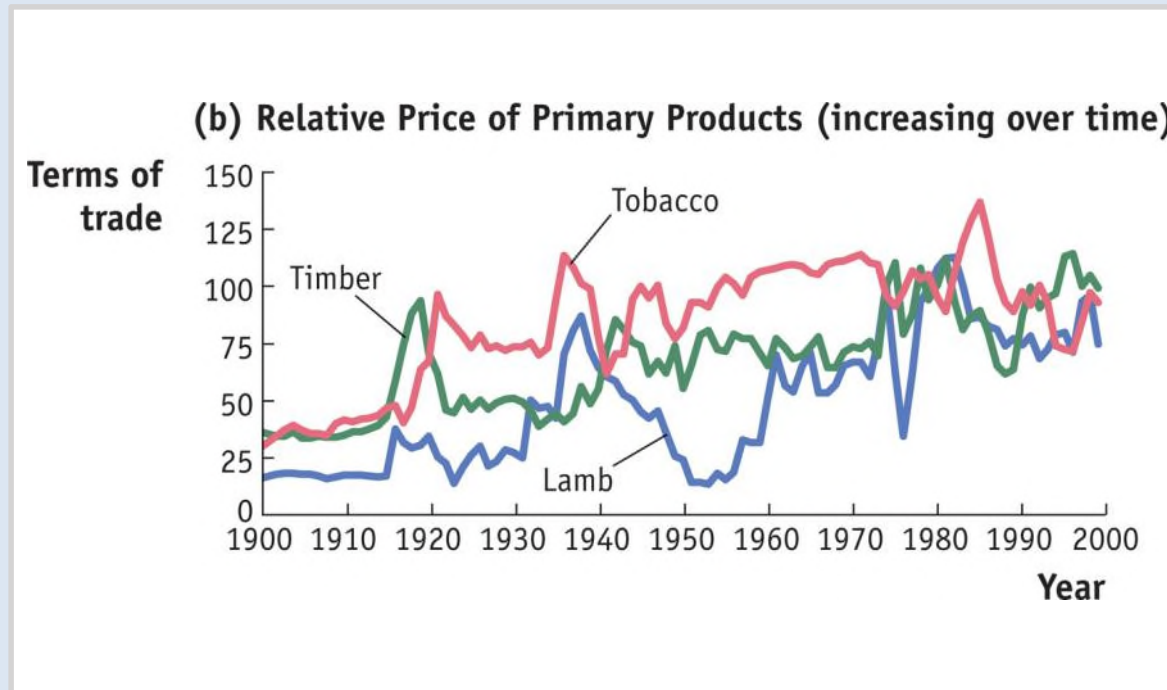
FIGURE 2-12 (Panel a)

Relative Price of Primary Commodities Shown here are the prices of various primary commodities relative to an overall manufacturing price, from 1900 to 1998. The relative prices of some primary commodities have fallen over time (panel a)…

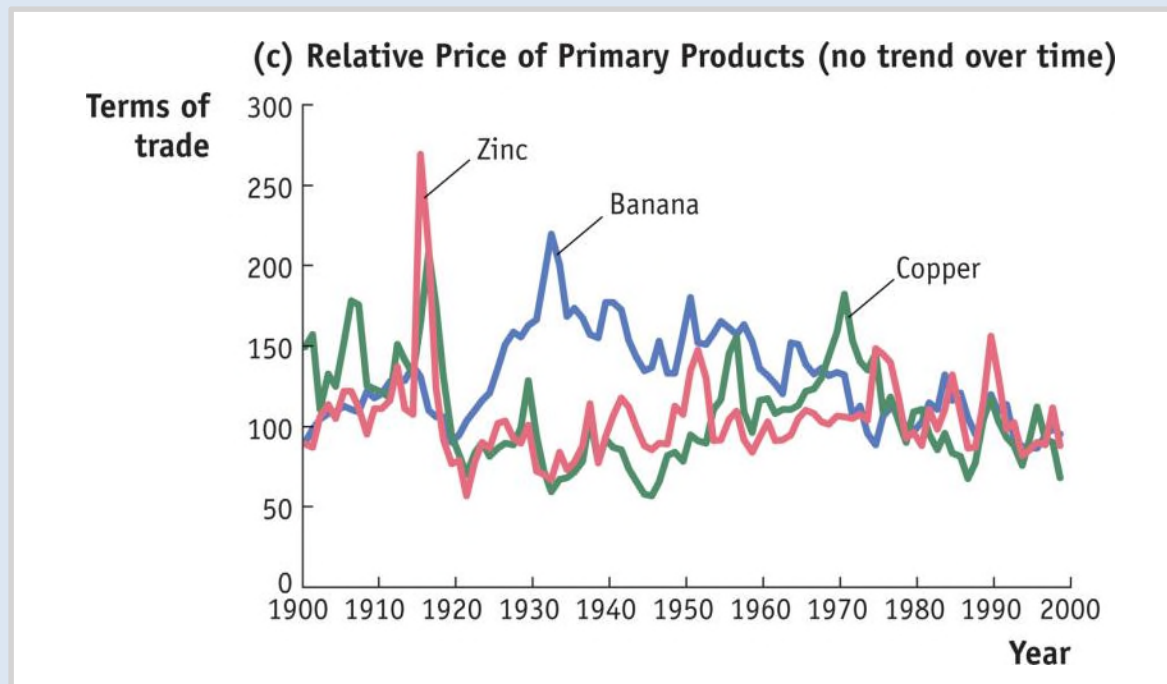## The Terms of Trade for Primary Commodities

FIGURE 2-12 (Panel b)

(b) Relative Price of Primary Products (increasing over time)

Relative Price of Primary Commodities … whereas other commodities have had rising relative prices (panel b)…

The Terms of Trade for Primary Commodities

FIGURE 2-12 (Panel c)

Relative Price of Primary Commodities … Other commodity prices show no consistent trend over time (panel c).

KEY POINTS

1. A country has comparative advantage in producing a good when the country's opportunity cost of producing the good is lower than the opportunity cost of producing the good in another country.

KEY POINTS

2. The pattern of trade between countries is determined by comparative advantage. This means that even countries with poor technologies can export the goods in which they have comparative advantage.

3. All countries experience gains from trade. That is, the utility of an importing or exporting country is at least as high as it would be in the absence of international trade.

KEY POINTS

4. The level of wages in each country is determined by its absolute advantage, that is, by the amount the country can produce with its labor. This result explains why countries with poor technologies are still able to export: their low wages allow them to overcome their low productivity.

5. The equilibrium price of a good on the world market is determined at the point where the export supply of one country equals the import demand of the other country.

KEY POINTS

6. A country's terms of trade equal the price of its export good divided by the price of its import good. A rise in a country's terms of trade makes it better off because it is exporting at higher prices or importing at lower prices.

KEY TERMS

import	natural resources	opportunity cost
export	labor resources	indifference curves
technology	capital	utility
resources	factors of production	relative price
offshoring	foreign direct investment	international trade equilibrium
proximity		
Ricardian model	absolute advantage	world price line
trade pattern	comparative advantage	gains from trade
free-trade area	marginal product of labor (MPL)	export supply curve
		import demand curve
	production possibilities frontier (PPF)	terms of trade