

Chapter 2 - Trade and Technology: The Ricardian Model

ECON 243 – International Trade

Chapter 2 - Trade and Technology: The Ricardian Model



Questions to Consider

1. What are reasons for countries to trade?
2. Will the country that is best at producing a good always export it?
3. How can countries compete with low-wage exporters, like China?

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Anyone Want to Trade?



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- Where did Cloe Kim's snowboard come from?
 - In 2018 the United States imported (i.e., purchased from other countries) \$28.5 million worth of snowboards from 19 different countries.
 - China exported (i.e., sold to another country) nearly \$12.7 million worth of snowboards to the United States in 2018.

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- Table 2-1 shows that the U.S. imported 366,089 snowboards from 19 countries in 2018 that were worth more than \$28 million.
- This pattern raises a 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, 2018

Rank	Country	Value of Imports (\$ thousands)	Quantity of Snowboards (thousands)	Average Price (\$/board)
1	China	\$12,664	224,018	\$57
2	Austria	6,940	53,318	130
3	United Arab Emirates	5,028	40,232	125
4	Taiwan	2,547	36,393	70
5	Tunisia	454	3,729	122
6	Canada	381	3,667	104
7	Australia	98	710	139
8	Poland	91	274	331
9	Switzerland	70	435	161
10	Netherlands	55	563	97
11	Japan	34	168	205
12	Hong Kong	27	871	31
13-19	All other countries	75	1,711	44
	Total	28,463	366,089	78

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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 them into the finished product in a final location)
- The proximity of countries to each other (i.e., how close they are to one another). The closer countries are, the lower the costs of transportation.

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- 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.

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Reasons for Trade

- Proximity**
 - The closer countries are, the lower the costs of transportation. For example, the largest trading partner of many European countries is another European country.
- Resources**
 - Geography includes 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.

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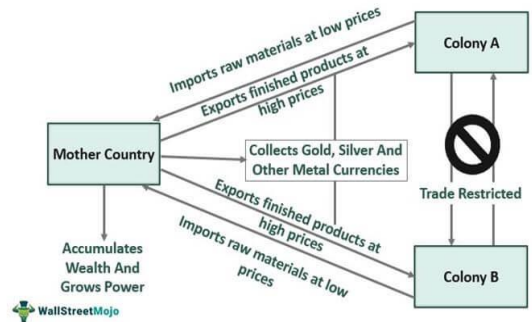
Chapter 2 - Trade and Technology: The Ricardian Model

Reasons for Trade

- **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.

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How Mercantilism Works?



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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.
- 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.
- Many of today's major international institutions around the world were founded at least in part on the idea that free trade between countries brings gains for all trading partners.



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A Few Comments

The principle of comparative advantage is not obvious. What important people have said about comparative advantage:

- David Ricardo first demonstrated the principle of comparative advantage in the early 19th century. [Principles of Political Economy was published in 1817]
- Paul Krugman has said that "comparative advantage is an idea that conflicts directly with both stubborn popular prejudices and powerful interests."
- Paul Samuelson described it as "...the best example I know of an economic principle that is undeniably true, yet not obvious to intelligent people."

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Chapter 2 - Trade and Technology: The Ricardian Model

Ricardian Model of Trade

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 United States and Europe.
 - Many types of cloth are imported into these countries.
 - For simplicity, we will ignore the role of land and capital and suppose that both goods are produced with labor alone.

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Ricardian Model of Trade

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 $MPL_C = 2$.

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Ricardian Model of Trade

The Home Country

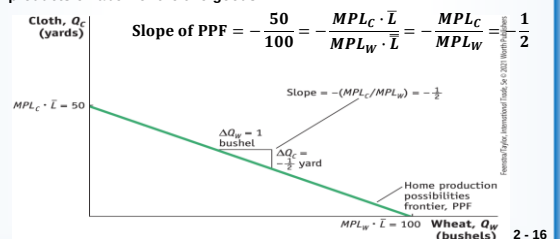
- Home Production Possibilities Frontier
 - We can graph Home's production possibilities frontier (PPF) using the marginal products for wheat and cloth.
 - The slope of the PPF is also the opportunity cost of wheat, the amount of cloth that must be given up to obtain one more unit of wheat.
 - If Home 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.

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Ricardian Model of Trade

The Home Country

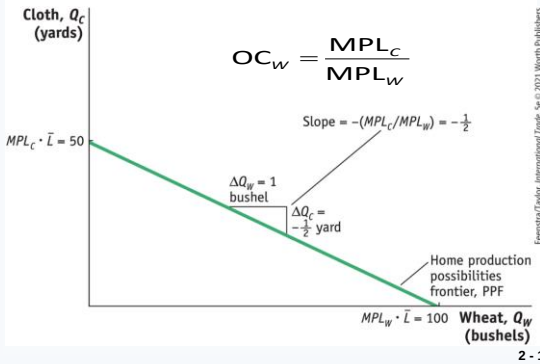
- Home Production Possibilities Frontier -The Home PPF is a straight line between 50 yards of cloth and 100 bushels of wheat. The slope of the PPF equals the negative of the opportunity cost of wheat. Equivalently, the magnitude of the slope can be expressed as the ratio of the marginal products of labor for the two goods. FIGURE 2-1



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A Closer Look



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Ricardian Model of Trade

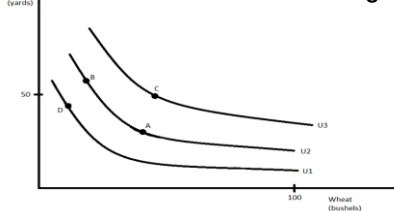
The Home Country

• Home Indifference Curve

- We will represent demand in the home economy using indifference curves that 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.

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Indifference Curves Once Again



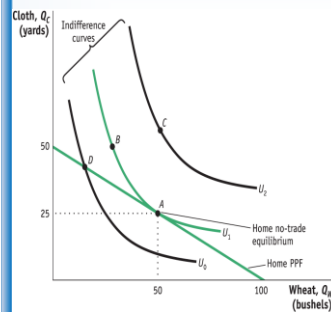
The consumer is indifferent between A and B but prefers C. The slope represents how many units of cloth you would give up in exchange for one unit of wheat (and remain indifferent). Remember from micro principles that the slope of an indifference curve at a given point is MU_x/MU_y at that point (the Marginal Rate of Substitution).

- When you consume little wheat, you are willing to give up a lot of cloth for one unit of wheat. That is why the IC is very steep when wheat consumption is low.
- When you consume a lot of wheat, you are willing to give up very little cloth for one unit of wheat. That is why the IC is less steep as wheat consumption increases.

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Ricardian Model of Trade

FIGURE 2-2



Home Equilibrium with No Trade

The Home Country

• Home Indifference Curve

- 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.

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Ricardian Model of Trade

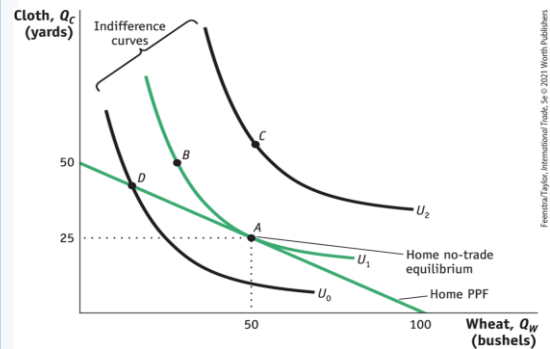
The Home Country

• Home Equilibrium

- In the absence of international trade, the production possibilities frontier acts like a budget constraint for the country, and with perfectly competitive markets, the economy will produce at the point of highest utility subject to the limits imposed by its PPF.
- The point of highest utility is at point A in Figure 2-2, where Home consumes 25 yards of cloth and 50 bushels of wheat.
- We will refer to point A as the “no-trade” or the “pre-trade” equilibrium for Home.

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A Closer Look - Figure 2-2



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Ricardian Model of 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.

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Ricardian Model of Trade

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.

$$\underbrace{MPL_W}_{\text{extra wheat produced}} \times \underbrace{p_W}_{\text{price of wheat}} = \underbrace{W}_{\text{cost of one unit of labor}} \quad \underbrace{W}_{\text{cost of one unit of labor}} = \underbrace{MPL_C}_{\text{extra cloth produced}} \times \underbrace{p_C}_{\text{price of cloth}}$$

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Ricardian Model of Trade

The Home Country

• Wages

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

$$P_W \cdot MPL_W = P_C \cdot MPL_C$$

- 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.

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Ricardian Model of Trade

The Foreign Country

- Assume a Foreign worker can produce 1 bushel of wheat or 1 yard of cloth.

$$MPL_W^* = 1, \quad MPL_C^* = 1$$

- 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.
- It is worth noting that Home has absolute advantage in both goods but will export only one, as explained later.

Remember Home : $MPL_W = 4, \quad MPL_C = 2$

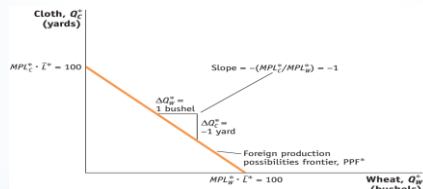
2 - 26

Ricardian Model of Trade

The Foreign Country

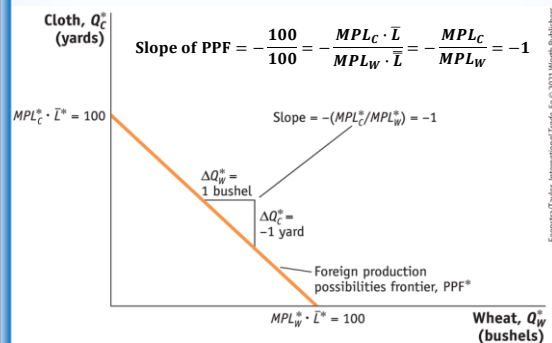
- The Foreign Production Possibilities Frontier
 - The Foreign PPF is a straight line between 100 yards of cloth and 100 bushels of wheat.
 - The slope of the PPF equals the negative of the opportunity cost of wheat.
 - The opportunity cost is the amount of cloth that must be given up (1 yard) to obtain 1 more bushel of wheat.

FIGURE 2-3



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A Closer Look



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Ricardian Model of Trade

The Foreign Country

- **Comparative Advantage**
 - 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.

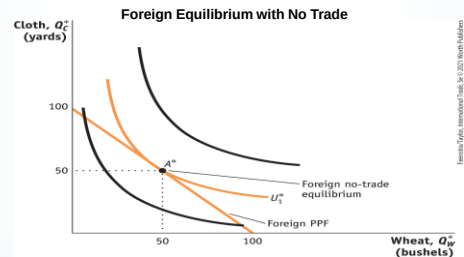
	Cloth (1 Yard)	Wheat (1 Bushel)
Home	2 Bushels of Wheat	$\frac{1}{2}$ Yard of Cloth
Foreign	1 Bushel of Wheat	1 Yard of Cloth

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Ricardian Model of Trade

The Foreign Country

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



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Application: Comparative Advantage in Apparel, Textiles, and Wheat

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 China has a lower opportunity cost and a comparative advantage in producing textiles and apparel.

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

	United States	China	Absolute Advantage
	<i>Sales/Employee</i>	<i>Sales/Employee</i>	<i>U.S./China Ratio</i>
Apparel	\$58,000	\$35,000	1.7
Textiles	\$135,000	\$34,000	4
	<i>Bushels/Worker</i>	<i>Bushels/Worker</i>	<i>U.S./China Ratio</i>
Wheat	13,500	450	30
	Comparative Advantage: United States	Comparative Advantage: China	
	<i>Bushels/\$</i>	<i>Bushels/\$</i>	
Opportunity cost of apparel	0.23	0.01	
Opportunity cost of Textiles	0.10	0.01	

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Determining the Pattern of International Trade

- **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

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Chapter 2 - Trade and Technology: The Ricardian Model

Determining the Pattern of International Trade

• 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 if 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.

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Determining the Pattern of International Trade

• 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

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Determining the Pattern of International Trade

• 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 that the free-trade price of P_W / P_C is $\frac{2}{3}$ (between the price of $\frac{1}{2}$ 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.

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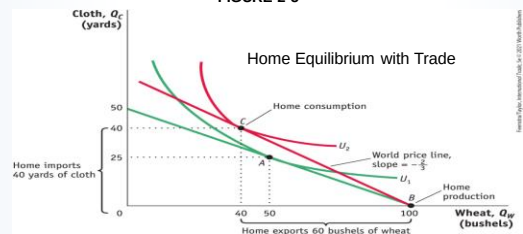
Determining the Pattern of International Trade

International Trade Equilibrium

• Change in Production and Consumption

- With a world relative price of wheat of $\frac{2}{3}$, Home production will occur at point B.
- Through international trade, Home is able to export each bushel of wheat it produces in exchange for $\frac{2}{3}$ yard of cloth.

FIGURE 2-5



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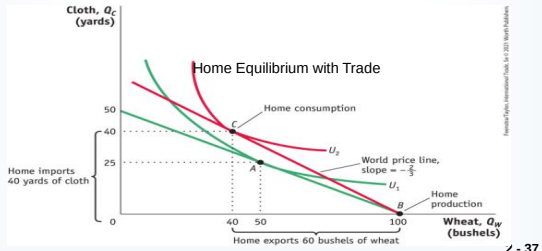
Determining the Pattern of International Trade

International Trade Equilibrium

Change in Production and Consumption

- 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.

FIGURE 2-5



Z - 37

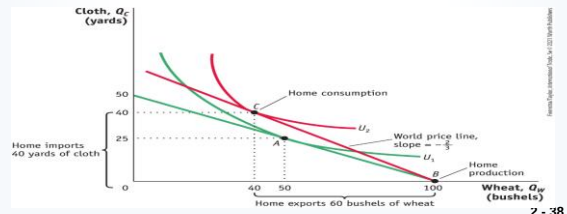
Determining the Pattern of International Trade

International Trade Equilibrium

Change in Production and Consumption

- 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.

FIGURE 2-5 Home Equilibrium with Trade



Z - 38

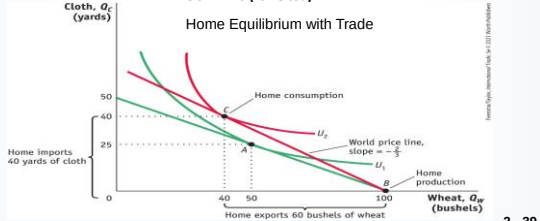
Determining the Pattern of International Trade

International Trade Equilibrium

International Trade

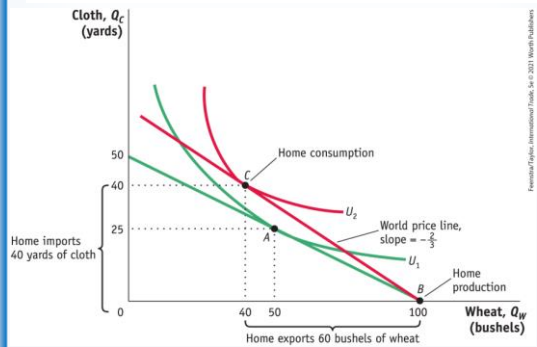
- Home obtains a higher utility with international trade than in the absence of trade (U_2 is higher than U_1).
- The finding that Home's utility increases with trade is our first demonstration of the gains from trade.

FIGURE 2-5 (revisited)



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A Closer Look at Home



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Information

- This diagram contains a great deal of information.
- Home produces 100 bushels of wheat. It consumes 40. It exchanges 60 bushels of wheat for 40 yards of cloth at relative price of $2/3$.
- Home's wheat exports = 60
- Home's cloth imports = 40
- Do a little bit of arithmetic: $60 \text{ bushels} \times \frac{2\$/\text{bu}}{3\$/\text{yard}} = 40 \text{ yards}$
- Rearrange this and we have: $60 \text{ bushels} \times 2 \frac{\$}{\text{bu}} = \$120 = 40 \text{ yards} \times 3 \frac{\$}{\text{yard}} = \$120$
- Revenue from exports equals expenditures on imports.

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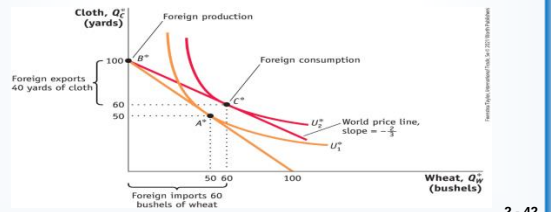
Determining the Pattern of International Trade

International Trade Equilibrium

Patterns of Trade and Gains from Trade

- With a world relative price of wheat of $\frac{2}{3}$, Foreign production will occur at point B^* .
- Through international trade, Foreign is able to export $\frac{2}{3}$ yard of cloth in exchange for 1 bushel of wheat, moving down the world price line.

FIGURE 2-6 - Foreign Equilibrium with Trade



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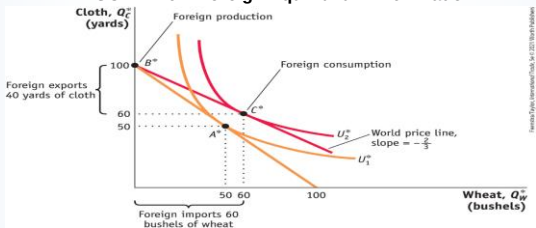
Determining the Pattern of International Trade

International Trade Equilibrium

Patterns of Trade and Gains from Trade

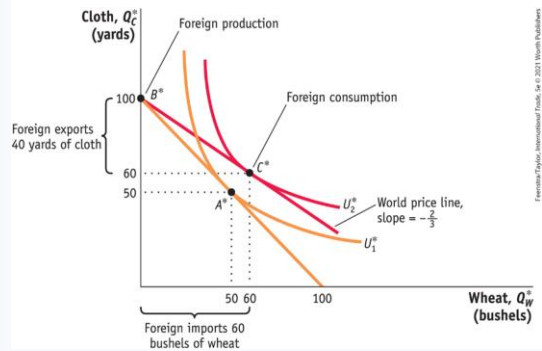
- Foreign consumption occurs at point C^* , and total exports are 40 yards of cloth in exchange for imports of 60 bushels of wheat. Relative to its pre-trade wheat and cloth consumption (point A^*), Foreign consumes 10 more bushels of wheat and 10 more yards of cloth.

FIGURE 2-6 - Foreign Equilibrium with Trade



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A Closer Look



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Chapter 2 - Trade and Technology: The Ricardian Model

Determining the Pattern of International Trade

- International Trade Equilibrium
- Patterns 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.

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Determining the Pattern of International Trade

- Solving for Wages Across Countries with a world relative price of wheat of 2/3

$$\text{Home Wage} = \begin{cases} MPL_w = 4 \text{ bushels of wheat} \\ \text{or} \\ (P_w/P_c) \cdot MPL_w = \frac{8}{3} \text{ yard of cloth} \end{cases}$$

$$\text{Foreign Wage} = \begin{cases} (P_c^*/P_w^*) \cdot MPL_c^* = \frac{3}{2} \text{ bushels of wheat} \\ \text{or} \\ MPL_c^* = 1 \text{ yard of cloth} \end{cases}$$

- Absolute Advantage
 - As our example shows, wages are determined by absolute advantage. In contrast, the pattern of trade in the Ricardian model is determined by comparative advantage.

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Application: Labor Productivity and Wages

FIGURE 2-7

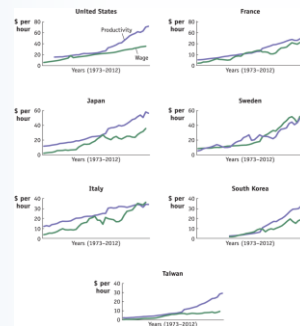


Labor Productivity and Wages, 2012 Labor productivity is measured by value-added per hour of work and can be compared with the wages paid in manufacturing in various countries.

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Application: Labor Productivity and Wages

FIGURE 2-8



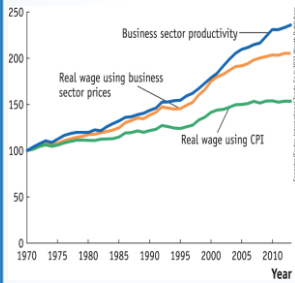
- The trends in labor productivity and real wages in manufacturing can also be graphed over time.
- The general upward movement in labor productivity is matched by upward movements in wages, as predicted by the Ricardian model.

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Chapter 2 - Trade and Technology: The Ricardian Model

Application: Labor Productivity and Wages

FIGURE 2-9

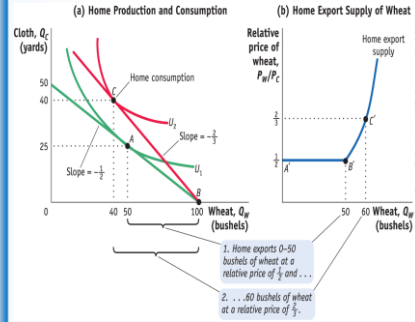


- The trends in labor productivity and real wages are shown for the business sector, including the production of goods and services, in the United States.
- When the real wage is measured relative to the business sector prices, then its growth is similar to labor productivity.

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Solving for International Prices

- FIGURE 2-10 Home Export Supply Curve

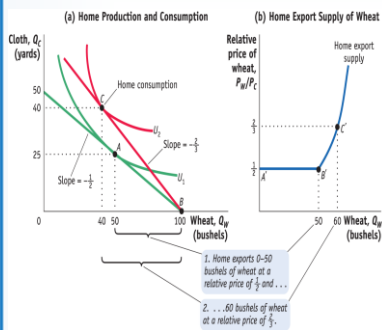


Home Export Supply Panel (a) repeats Figure 2-5, showing the trade equilibrium for Home with production at point B and consumption at point C. Panel (b) shows the home export supply of wheat.

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Solving for International Prices

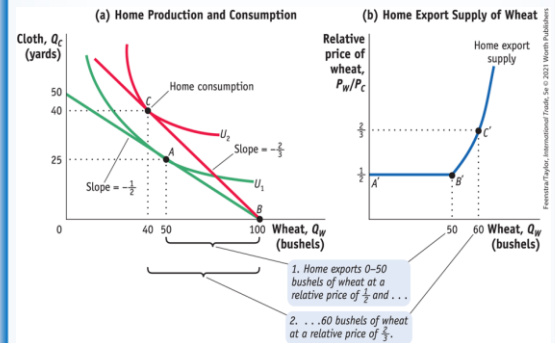
- FIGURE 2-10 Home Export Supply Curve



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.

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A Closer Look

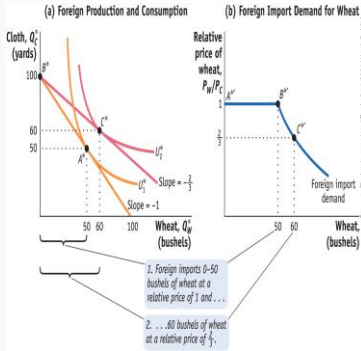


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Chapter 2 - Trade and Technology: The Ricardian Model

Solving for International Prices

Figure 2-11 - Foreign Import Demand Curve

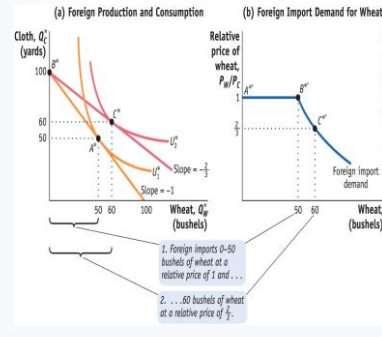


Foreign Import Demand Panel (a) repeats Figure 2-6. Panel (b) shows foreign import demand for wheat. When the relative price of wheat is 1, Foreign will import any amount of wheat between 0 and 50 bushels, along the segment A'B' of the foreign import demand curve.

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Solving for International Prices

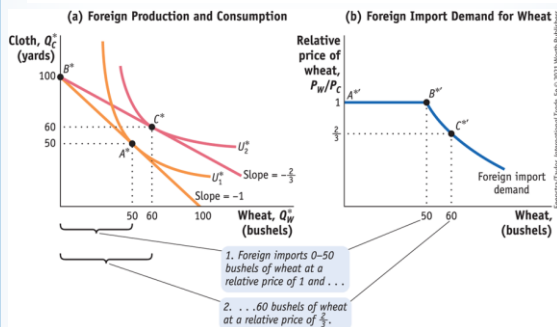
Figure 2-11 - Foreign Import Demand Curve



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

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A Closer Look

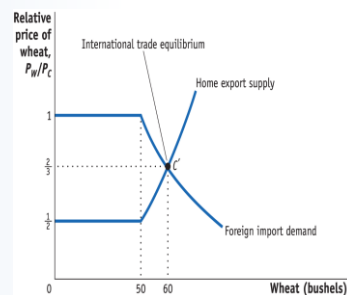


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Solving for International Prices

- International Trade Equilibrium

FIGURE 2-12

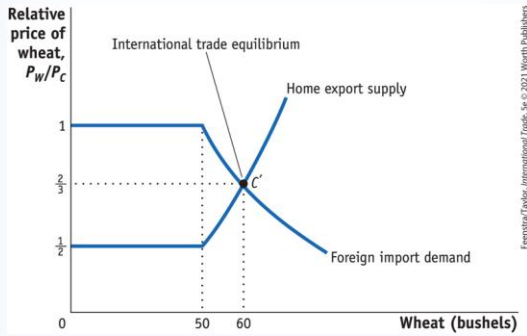


World Market for Wheat Putting together the Home export supply curve and the Foreign import demand curve for wheat, the world equilibrium is established at point C', where the relative price of wheat is $\frac{2}{3}$.

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Chapter 2 - Trade and Technology: The Ricardian Model

A Closer Look



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Solving for International Prices

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_C/P_W) 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.

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Application: 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.

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Prebisch-Singer Hypothesis



The Prebisch-Singer Hypothesis (PSH) is more of an observation rather than a complex theory. It suggests that over the long run the price of primary goods such as coal, coffee cocoa declines in proportion to manufactured goods such as cars, washing machines and computers

<https://www.slideshare.net/tutor2u/topical-issues-in-trade-and-development>

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Chapter 2 - Trade and Technology: The Ricardian Model

Conclusions

- The Ricardian model was developed as a response to the mercantilist idea that exports are good and imports are bad.
- Using differences in technology and opportunity cost, Ricardo demonstrated that the pattern of trade is determined by comparative advantage and that both countries gain from trade.
- Wages depend on the marginal products of labor in each country and are determined by absolute advantage: a country with better technology will be able to pay higher wages.
- The fact that only labor is used in the Ricardian model, with a constant marginal product of labor, makes it special. The PPF is a straight line, and the export supply and import demand curves each have a flat segment.

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Key Points

1. A country has a 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.
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 a 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.

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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.
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.

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