The Ricardian Model

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Required Reading:

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TRADE AND TECHNOLOGY

- Reasons for Trade
- Ricardian Model
- Determining the Pattern of International Trade
- Solving for International Prices
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)

- In this lecture 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.
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. 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.
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.
- 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 $MPL_C = 2$
**BE CAREFUL:** Sometimes the level of technology is expressed in terms of the *Unit Labor Requirement* \((a)\): the amount of labor required to increase output by one unit. This is the inverse of the marginal product of labor \((MPL)\),

\[
a = \frac{1}{MPL}
\]

In our example:

- In Home, one bushel of wheat requires: \(a_w = \frac{1}{MPL_w} = \frac{1}{4}\) workers
- Alternatively, one yard of cloth requires: \(a_c = \frac{1}{MPL_c} = \frac{1}{2}\) workers
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.
Examples of Production Possibility Frontiers (PPF)

**Increasing Opportunity Costs (bowed out PPF)**

**Constant Opportunity Costs (linear PPF)**

The Ricardian model assumes a constant opportunity cost (b)
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.
Ricardian Model

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.
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 is not attainable in the absence of international trade.
Ricardian Model

Opportunity Cost and Prices

- The slope of the PPF (in absolute value) reflects the opportunity cost of producing one more bushel of wheat (always the good represented on the x-axis).

- The opportunity cost of cloth is simply the inverse of the opportunity cost of wheat. Why?

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

- Therefore, the relative price reflects the opportunity cost of a good.
Ricardian Model

**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.

- 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 relative price of wheat = \(\text{slope of the PPF} \) (the opportunity cost)
Ricardian Model

The Foreign Country

- Assume a Foreign worker can produce one bushel of wheat or one yard of cloth: $MPL^*_W = 1$ ; $MPL^*_C = 1$

- In terms of Unit Labor Requirements:
  
  ✓ One bushel of wheat requires: $a^*_W = \frac{1}{MPL^*_W} = 1$ worker
  
  ✓ One yard of cloth requires: $a^*_C = \frac{1}{MPL^*_C} = 1$ worker

- Assume there are 100 workers available in Foreign.

- If all workers were employed in wheat they could produce 100 bushels. However, if all workers were employed in cloth they could produce 100 yards.
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.
The highest level of Foreign utility on the PPF is obtained at point $A^*$, which is the no-trade equilibrium.
Ricardian Model: 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.

<table>
<thead>
<tr>
<th></th>
<th>Cloth (1 Yard)</th>
<th>Wheat (1 Bushel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>2 Bushels of Wheat</td>
<td>½ Yard of Cloth</td>
</tr>
<tr>
<td>Foreign</td>
<td>1 Bushel of Wheat</td>
<td>1 Yard of Cloth</td>
</tr>
</tbody>
</table>

*The inverse of the absolute value of the Slope of PPFs*

*Absolute value of the Slope of Home’s PPF*

*Absolute value of the Slope of Foreign’s PPF*
Determining the Pattern of International Trade

- 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.

**Exports and imports will be determined by the opportunity costs of production in each country**
The two countries are in an international trade equilibrium when the relative price of wheat is the same in the two countries.

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.
Determining the Pattern of International Trade

- 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 $\frac{1}{2}$ 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.
With a world relative price of wheat of \(2/3\), Home production will occur at point B. Home is able to export each bushel of wheat it produces in exchange for \(2/3\) yard of cloth.
Determining the Pattern of International Trade

Home Equilibrium with Trade

- Home’s exports and imports are equal when valued in the same units: Home exports 60 bushels of wheat; multiplying this by the price of wheat in terms of cloth (2/3) gives 40.

- **Gains from Trade:** Home’s utility increases since $U_2$ is higher than $U_1$

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.
Determining the Pattern of International Trade

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.
Determining the Pattern of International Trade

**Foreign Equilibrium with 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.
Determining the Pattern of International Trade

- **First lesson of the Ricardian model:**
  - Each country is exporting the good for which it has the comparative advantage, so the pattern of trade is determined by comparative advantage → *Complete specialization*

- **The second lesson of the Ricardian model:**
  - There are gains from trade for both countries.
Take a Break

10 min
Determining the Pattern of International Trade

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:

  $\left(\frac{P_W}{P_C}\right)MPL_W = (2/3) \cdot 4 = 8/3$ yards
Determining the Pattern of International Trade

Solving for Real Wages Across Countries

<table>
<thead>
<tr>
<th></th>
<th>Autarky (No-trade)</th>
<th>With Free Trade and complete specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home workers</strong></td>
<td>$MPL_W = 4 \text{ bushels of wheat}$</td>
<td>$MPL_W = 4 \text{ bushels of wheat}$</td>
</tr>
<tr>
<td></td>
<td>$MPL_C = 2 \text{ yards of cloth}$</td>
<td>$(\frac{2}{3})MPL_W = \frac{8}{3} \text{ yards of cloth}$</td>
</tr>
<tr>
<td><strong>Foreign workers</strong></td>
<td>$MPL^*_W = 1 \text{ bushel of wheat}$</td>
<td>$MPL^*_C = 1 \text{ yard of cloth}$</td>
</tr>
<tr>
<td></td>
<td>$MPL^*_C = 1 \text{ yard of cloth}$</td>
<td>$(\frac{3}{2})MPL^*_C = \frac{3}{2} \text{ bushels of wheat}$</td>
</tr>
</tbody>
</table>

- Home workers are better off with trade because they can afford to buy the same amount of wheat as before but more cloth: $\frac{8}{3} > 2$
- Foreign workers are also better off since they can afford to buy the amount of cloth but more wheat: $\frac{3}{2} > 1$
Solving for Real Wages Across Countries

- Since Home has an absolute advantage in the production of both goods, Foreign workers earn less than Home workers as measured by their ability to purchase either good.

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

- This two results are linked since the only way that a country with poor technology can export at a price others are willing to pay is by having low wages.

- In the Ricardian model, workers can receive higher wages with the technological progress.
**Solving for International Prices**

*Home Export Supply Curve:* shows the amount of home exports of wheat at different relative prices.

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 $\frac{2}{3}$. 

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(a) Home Production and Consumption

- **Cloth, $Q_C$ (yards):**
  - Points: A, B, C
  - Slope = $-\frac{1}{2}$

(b) Home Export Supply of Wheat

- **Relative price of wheat, $P_W/P_C$:**
  - Points: A', B', C'
  - Home export supply

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Wheat, $Q_W$ (bushels)

- Points: 0, 40, 50, 100

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Home consumption

- Points: A, B, C

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Slope = $-\frac{2}{3}$
Solving for International Prices

**Foreign Import Demand Curve:** shows the amount of foreign imports of wheat at different relative prices.

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 \( \frac{2}{3} \).
Solving for International Prices

*International Trade Equilibrium:* the quantity and relative price at which Home exports equal Foreign imports of wheat.

Recall that we assumed the relative price before, $P_W/P_C = 2/3$, now we get it from the international market.
Solving for International Prices

Recall the Terms of Trade: the price of a country’s exports divided by the price of its imports.

- Because Home exports wheat, $\left( \frac{P_W}{P_C} \right)$ is its terms of trade.
- Foreign exports cloth, so $\left( \frac{P_C}{P_W} \right)$ is its terms of trade.
- Thus, 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.
Some Final Comments

- The Ricardian model provides a motive for trade between developed and developing countries.

- If the model holds, we can offer strong refutations to common criticisms of free trade:

  ✓ “Free Trade is beneficial only if your country is strong enough to stand up to foreign competition”.
    → Comparative and not absolute advantage is sufficient for gains from trade

  ✓ “Foreign competition is unfair and hurts other countries when it is based on low wages”
    → Low foreign wages are caused by low productivity.

  ✓ “Trade exploits a country and makes it worse off if its workers receive much lower wages than workers in other nations”
    → If wages are based on productivity, they will be low even if there is no trade.
Some Final Comments

- However...

  - The model does not explain why differences in productivity levels between countries exist.

  - It makes extreme and unrealistic predictions such as countries will completely specialize in the production of exportables only.