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## The Ricardian Model of Trade

**Big Idea:** Trade is driven by differences in technology/productivity across countries. Even if one country is absolutely better at producing everything, both countries benefit from trade based on **comparative advantage** (relative efficiency).

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### Core Principles

#### Foundation

- **Comparative Advantage:** Countries benefit from trade by specializing in goods they produce at lower *opportunity cost*, not necessarily lower absolute cost
  - This is David Ricardo's revolutionary insight (1817)
  - Counters the intuition that only absolutely efficient countries benefit from trade
- **Single Factor of Production:** Labor is the only factor of production
  - Simplifies analysis to focus on technological differences
  - Labor productivity varies across countries and goods
- **Perfect Competition:** Markets are perfectly competitive
  - Firms are price-takers
  - Zero economic profits in equilibrium
- **Constant Returns to Scale:** Technology exhibits constant returns to labor
  - Doubling labor input doubles output
  - Implies linear PPF
- **Perfect Labor Mobility:** Labor can move freely between sectors within a country, but not between countries
  - Ensures wage equalization across sectors within a country
  - International wage differences can persist

## Model Setup

### Technology

Production is characterized by unit labor requirements:

- **a<sub>c</sub>**: Labor hours needed to produce 1 unit of cloth
- **a<sub>w</sub>**: Labor hours needed to produce 1 unit of wine

### Production Possibilities Frontier (PPF)

Given total labor endowment L:

- Cloth production: Q<sub>c</sub>
- Wine production: Q<sub>w</sub>

**Labor constraint:** a<sub>c</sub> · Q<sub>c</sub> + a<sub>w</sub> · Q<sub>w</sub> ≤ L

**PPF equation:** Q<sub>c</sub> = L/a<sub>c</sub> - (a<sub>w</sub>/a<sub>c</sub>) · Q<sub>w</sub>

**Slope of PPF** = -(a<sub>w</sub>/a<sub>c</sub>) = opportunity cost of wine in terms of cloth

### Autarky (No Trade)

#### Equilibrium Conditions

1. **Production:** Economy operates on its PPF
2. **Consumption:** Economy consumes what it produces
3. **Relative Price:** Determined by opportunity cost

**Autarky relative price:** P<sub>w</sub>/P<sub>c</sub> = a<sub>w</sub>/a<sub>c</sub>

The relative price equals the slope of the PPF (in absolute value).

### Wage Determination

In competitive equilibrium:

- Wage in cloth sector: w = P<sub>c</sub>/a<sub>c</sub>
- Wage in wine sector: w = P<sub>w</sub>/a<sub>w</sub>

Both sectors pay the same wage, or workers would move between sectors.

### Two-Country Model

#### Comparative Advantage Principle

Consider Home and Foreign (Foreign variables denoted with \*):

**Home has comparative advantage in cloth if:** a<sub>c</sub>/a<sub>w</sub> < a<sub>c\*</sub>/a<sub>w\*</sub>

Equivalently:

- (P<sub>w</sub>/P<sub>c</sub>)<sub>autarky,Home</sub> < (P<sub>w</sub>/P<sub>c</sub>)<sub>autarky,Foreign</sub> - Home's opportunity cost of cloth is lower

**Foreign has comparative advantage in wine if:** a<sub>w</sub>/a<sub>c</sub> < a<sub>w\*</sub>/a<sub>c\*</sub>

#### Numerical Example: Classic Case

#### Setup:

Country	Cloth (hours/yard)	Wine (hours/gallon)	Total Labor
Home	a <sub>c</sub> = 1	a <sub>w</sub> = 2	L = 100
Foreign	a <sub>c*</sub> = 2	a <sub>w*</sub> = 3	L* = 100

**Step 1: Check for Absolute Advantage** - Home is absolutely more efficient in both goods (lower labor requirements) - Home can produce: 100 cloth OR 50 wine - Foreign can produce: 50 cloth OR 33.33 wine - Naive view: "Why would Home trade with Foreign?"

### Step 2: Calculate Opportunity Costs

*Home's opportunity costs:* - To produce 1 wine, give up:  $a_w/a_c = 2/1 = \mathbf{2 \text{ cloth}}$  - To produce 1 cloth, give up:  $a_c/a_w = 1/2 = \mathbf{0.5 \text{ wine}}$

*Foreign's opportunity costs:* - To produce 1 wine, give up:  $a_w/a_c = 3/2 = \mathbf{1.5 \text{ cloth}}$  - To produce 1 cloth, give up:  $a_c/a_w = 2/3 = \mathbf{0.67 \text{ wine}}$

**Step 3: Identify Comparative Advantage** - **Home has comparative advantage in cloth:** Gives up only 0.5 wine vs. Foreign's 0.67 wine - **Foreign has comparative advantage in wine:** Gives up only 1.5 cloth vs. Home's 2 cloth - Notice: Home has absolute advantage in both, but comparative advantage in only one!

**Step 4: Autarky Relative Prices** - Home:  $P_w/P_c = 2$  (wine costs twice as much as cloth) - Foreign:  $P_w/P_c^* = 1.5$  (wine costs 1.5 times as much as cloth) - Wine is relatively cheaper in Foreign; cloth is relatively cheaper in Home

**Result:** Foreign has comparative advantage in wine; Home has comparative advantage in cloth.

## Trade Equilibrium

### Pattern of Specialization

Under free trade with relative price  $P_w/P_c$ :

**Home specializes in cloth if:**  $P_w/P_c > a_w/a_c$  **Foreign specializes in wine if:**  $P_w/P_c < a_w/a_c$

### World Relative Supply and Demand

**Complete Specialization:** - Home produces:  $Q_c = L/a_c$  cloth (100 yards in our example) - Foreign produces:  $Q_w^* = L/a_w$  wine (33.33 gallons in our example)

**World relative supply (RS):** - Perfectly inelastic (vertical line) at  $RS = (L/a_c)/(L/a_w) = 100/33.33 = 3$  - Interpretation: World produces 3 times as much cloth as wine

**World relative demand (RD):** - Downward sloping: as  $P_w/P_c$  increases, relative demand for wine decreases - Higher wine price → consumers substitute toward cloth →  $D_w/D_c$  falls

### Equilibrium Relative Price

The trade equilibrium relative price must lie between the two autarky prices:

$$\mathbf{1.5 < (P_w/P_c)trade < 2}$$

From our example:  $(P_w/P_c)_{\text{Home}} = 2$  and  $(P_w/P_c)_{\text{Foreign}^*} = 1.5$

**Concrete Example:** Suppose  $(P_w/P_c)_{\text{trade}} = 1.7$  - Home exports cloth, imports wine - Foreign exports wine, imports cloth - Both countries face the same world price

## Demonstrating Mutual Gains from Trade

**Home's Perspective** (exports cloth): - *Autarky*: Producing 1 wine requires sacrificing 2 cloth ( $P_w/P_c = 2$ ) - Equivalently: 1 cloth can "buy" only 0.5 wine through domestic production - *Trade*: Can trade 1 cloth for  $1/1.7 = 0.588$  wine on world market - **Gain**: Gets 0.588 wine instead of 0.5 wine per cloth

**Foreign's Perspective** (exports wine): - *Autarky*: Producing 1 cloth requires sacrificing  $2/3 = 0.67$  wine ( $P_c/P_w^* = 1/1.5 = 0.67$ ) - Equivalently: 1 wine can "buy" 1.5 cloth through domestic production - *Trade*: Can trade 1 wine for 1.7 cloth on world market - **Gain**: Gets 1.7 cloth instead of 1.5 cloth per wine

**Key Insight:** The world price ( $P_w/P_c = 1.7$ ) makes: - Cloth cheaper for Foreign than producing it domestically - Wine cheaper for Home than producing it domestically - **Both countries gain by specializing in their comparative advantage!**

## Gains from Trade

### Sources of Gains

1. **Consumption gains**: Countries can consume beyond their PPF
2. **Production efficiency**: Resources allocated to comparative advantage sectors
3. **Terms of trade**: Exchange at favorable relative prices

## Graphical Analysis

Each country's consumption possibilities expand: - Autarky: Consumption = Production on PPF  
- Trade: Consumption on a flatter budget line through the production point

**Budget constraint with trade:**  $P_c \cdot D_c + P_w \cdot D_w = P_c \cdot Q_c + P_w \cdot Q_w$

where D denotes consumption and Q denotes production.

### Numerical Example: Consumption Gains

Using our earlier example with  $(P_w/P_c)_{\text{trade}} = 1.7$ :

**Home (exports cloth)**: - Autarky production:  $C = 50$ ,  $W = 25$  - Trade production:  $C = 100$ ,  $W = 0$  (complete specialization) - Trade consumption: Export some cloth for wine at rate 1.7 - Can consume anywhere on line:  $C + 1.7W = 100$  - If preferences lead to consuming 50 cloth and 29.4 wine - **Gain**: More wine than autarky ( $29.4 > 25$ )

**Foreign (exports wine)**: - Autarky production:  $C^* = 25$ ,  $W^* = 16.7$  - Trade production:  $C^* = 0$ ,  $W^* = 33.3$  (complete specialization) - Trade consumption: Export wine for cloth at world prices - Can consume on line determined by trade - Gets access to more cloth at lower opportunity cost - **Gain**: Able to consume combinations beyond autarky PPF

### Visual Summary:

Home:	Autarky → Trade
Cloth:	50 → 50 (consumed)
Wine:	25 → 29.4 (consumed)
Welfare:	↑ (more wine!)

Foreign:	Autarky → Trade
Cloth:	25 → 28.3 (consumed)
Wine:	16.7 → 16.7 (consumed)
Welfare:	↑ (more cloth!)

## Welfare Implications

- Both countries gain from trade (Pareto improvement at country level)
- Trade allows consumption of combinations impossible in autarky
- Real wages increase when measured in terms of the imported good
- More productive country (Home) often captures larger share of gains
- Division of gains depends on where world price settles between autarky prices

## Real Wages and Distribution

### Real Wage in Terms of Cloth

$$w/P_c = 1/a_c \text{ (always)}$$

### Real Wage in Terms of Wine

- Autarky:  $w/P_w = 1/a_w$
- Trade (Home exports cloth):  $w/P_w = (P_c/P_w) \cdot (1/a_c) > 1/a_w$

**Result:** Real wages rise in terms of the imported good, unchanged in terms of exported good.

## Distribution Within Countries

**No conflict:** All workers gain from trade (or at least don't lose) because:  
 - Labor is the only factor  
 - Labor is perfectly mobile between sectors - All workers earn the same wage

This contrasts with models with multiple factors (Specific Factors, HO).

## Limitations of Ricardian Model

### What It Explains Well

- Pattern of trade based on technology differences
- Gains from trade
- Why countries with different productivities trade

### What It Cannot Explain

1. **Income distribution:** No winners/losers within countries
2. **Multiple factors:** Ignores capital, land, other inputs
3. **Increasing returns:** Assumes constant returns
4. **Transport costs:** Assumes zero transport costs
5. **Source of comparative advantage:** Technology differences are assumed, not explained
6. **Incomplete specialization:** Predicts complete specialization; reality shows diversified production

## Extensions and Applications

### Many Goods

With multiple goods, arrange by comparative advantage: - Home exports goods where  $a_i/a_{i^*}$  is lowest - Foreign exports goods where  $a_{i^*}/a_i$  is lowest - Relative wages determine the cutoff

### Many Countries

- Chain of comparative advantage
- Each country exports goods where it has comparative advantage
- Trade patterns determined by relative productivities and wages

### Empirical Evidence

**Success:** - Countries do export goods in which they have relatively high productivity - Relative export prices correlate with relative unit labor requirements

**Limitations:** - Incomplete specialization common - Need to incorporate other factors (capital, resources)

### Key Takeaways

1. **Comparative advantage**, not absolute advantage, determines trade patterns
2. **Opportunity cost** is the relevant metric for specialization
3. **Mutual gains from trade** exist even when one country is more productive in everything
4. **Technology differences** drive trade in the Ricardian framework
5. **Complete specialization** is the typical outcome with perfect mobility
6. **All workers benefit** from trade in this simple model (important contrast with later models)

## Problem-Solving Framework

### Finding Comparative Advantage

1. Calculate opportunity costs:  $a_i/a_j$  for each country
2. Compare opportunity costs across countries
3. Lower opportunity cost = comparative advantage

### Determining Trade Pattern

1. Identify comparative advantages
2. Countries export goods with comparative advantage
3. Trade price must lie between autarky prices

### Calculating Gains

1. Find autarky consumption (on PPF with preferences)
2. Find trade production (complete specialization)
3. Find trade consumption (on budget line through production)
4. Compare utility/consumption between autarky and trade