International Trade: Lecture 2

Intro to Classical Ricardian Trade

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David Ricardo (1772–1823)

- Born: April 18, 1772, London (third of 17 children)
- Career: Achieved wealth through disciplined financial trading in government consols and loans
- Major Work: *On the Principles of Political Economy and Taxation* (1817) – foundational text on comparative advantage, value, rent, etc.
- Public Life: MP for Portarlington (1819–1823), promoting free trade, currency reform, and abolition
- Death: Died Sept. 11, 1823, age 51, from septic ear infection

David Ricardo (public domain image)

Ricardian Model: Preliminaries

- Consider a world with 2 countries (US, Colombia) and 2 products (Computers, Roses)
- Set of countries $i \in \{US, COL\}$; set of products $p \in \{C, R\}$
- In country i, there are L_i units of labor (worker-hours) available
- In country i, to produce one unit of good p, firms use $a_{i,p}$ units of labor
- $Y_{i,p}$ is total production of good p in i
- To produce $Y_{i,C}$ units of computers in i, firms use $a_{i,C} \times Y_{i,C}$ units of labor
- We call $a_{i,p}$ the **unit labor requirements**
  - The higher $a_{i,p}$, the **less productive** country i is in producing p. Why?
- Trade is balanced

Production Possibilities Frontier

- Total labor can be distributed for the production of either good, such that:

$$\underbrace{a_{i,C} \times Y_{i,C}}_{\substack{\text{labor used in} \\ \text{production of } C}} + \underbrace{a_{i,R} \times Y_{i,R}}_{\substack{\text{labor used in} \\ \text{production of } R}} \leq \underbrace{L_i}_{\substack{\text{total labor} \\ \text{available in } i}}$$

- Inequality above defines set of feasible production choices, formally:

$$\mathcal{Y}_i = \{(Y_{i,C}, Y_{i,R}) : a_{i,C} \times Y_{i,C} + a_{i,R} \times Y_{i,R} \leq L_i\}$$

- English: if labor used to produce $(Y_{i,C}, Y_{i,R})$ is not larger than L_i, production is feasible

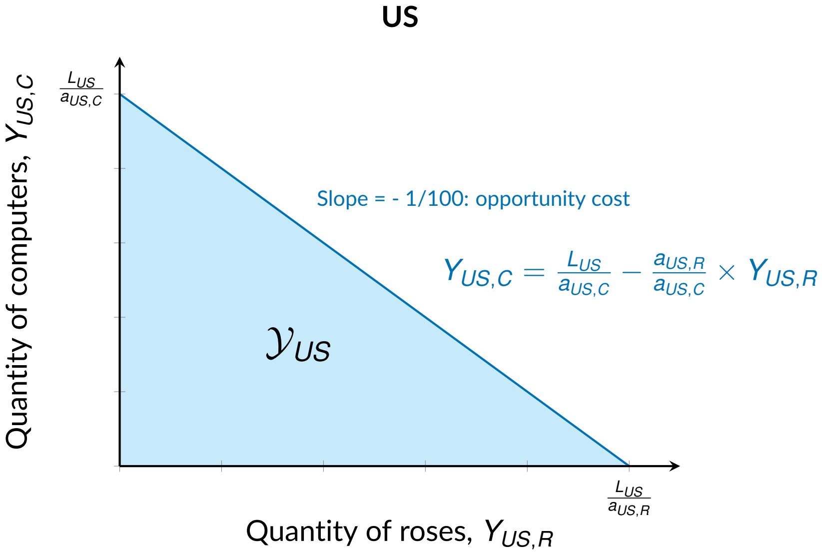
Production Possibilities Frontier, Example

- There are 300 million units of labor in the US ($L_{US} = 300$ million)
- To produce one rose in the US, firms use 30 units of labor ($a_{US,R} = 30$)
- To produce one computer in the US, firms use $3,000$ units of labor ($a_{US,C} = 3,000$)
- How many units of either good can the US make?
  - If it fully specializes in R, it can produce $Y_{US,R} = L_{US}/a_{US,R} = 300$ million$/30 = 10$ million roses.
  - If it fully specializes in C, it can produce $Y_{US,C} = L_{US}/a_{US,C} = 300$ million$/3,000 = 100,000$ computers.
- In general, it can produce any combination $(Y_{US,R}, Y_{US,C})$ that satisfies:

$$3,000 \times Y_{US,C} + 30 \times Y_{US,R} \leq 300 \text{ million}$$

- Opportunity cost: $a_{US,R}/a_{US,C} = 30/3000 = 1/100$ computers per rose
  (or $a_{US,C}/a_{US,R} = 100$ roses per computer)

Production Possibilities Frontier, Graphical Example



Production Technology

- In country i, firms producing good p maximize profits under perfect competition:

$$\max_{Y_{i,p}} \pi_{i,p} = \max_{Y_{i,p}} P_{i,p} Y_{i,p} - w_i a_{i,p} Y_{i,p}$$

- Since labor only one type of labor (mobile across sectors), there is a single wage w_i
- In equilibrium, **prices equal marginal cost** in each productive sector:

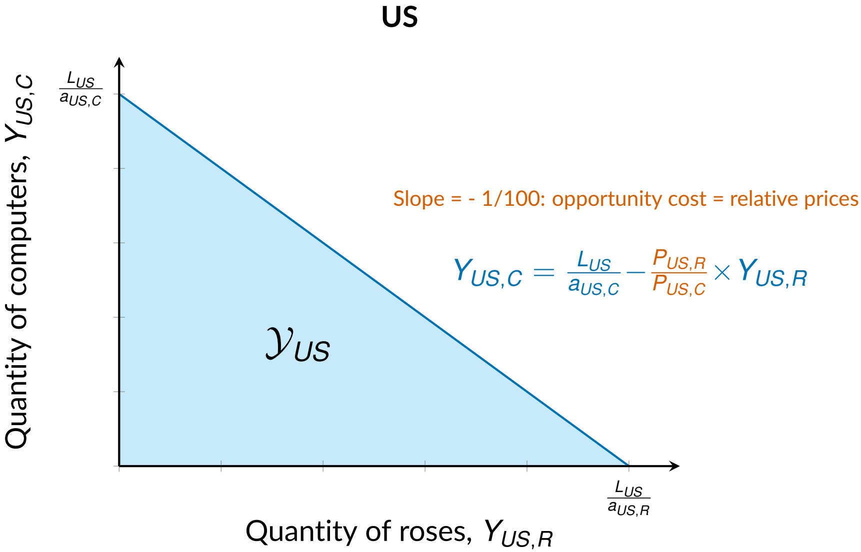
$$P_{i,p} = w_i a_{i,p} \iff \frac{P_{i,p}}{a_{i,p}} = w_i \qquad \text{for } p \in \{C, R\}$$

- In autarky equilibrium, there demand and production in both sectors
- We can pin down the relative price $P_{i,C}/P_{i,R}$:

$$\frac{P_{i,C}}{a_{i,C}} = w_i = \frac{P_{i,R}}{a_{i,R}} \iff \frac{P_{i,C}}{P_{i,R}} = \frac{a_{i,C}}{a_{i,R}}$$

- In autarky, relative prices will reflect the **opportunity cost** within country i

Production Possibilities Frontier, Graphical Example



Preferences

- In country i, consumers preferences over products p, represented by a utility function:

$$U_i(Q_C, Q_R) \equiv Q_C^{\alpha_i} Q_R^{1-\alpha_i}, \qquad \text{for } 0 < \alpha_i < 1$$

- How to derive indifference curves?

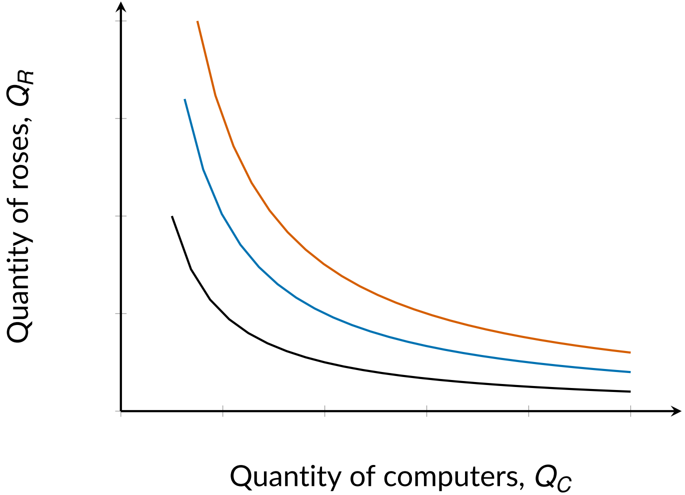
$$U_i = Q_C^{\alpha_i} Q_R^{1-\alpha_i} \iff Q_C^{\alpha_i} = U_i \times Q_R^{-(1-\alpha_i)} \iff Q_C = U_i^{\frac{1}{\alpha_i}} \times Q_R^{-\frac{1-\alpha_i}{\alpha_i}}$$

- Example: Suppose $\alpha_i = 1/2$. Then:

$$Q_C = U_i^{\frac{1}{1/2}} \times Q_R^{-\frac{1-1/2}{1/2}} = U_i^2 \times Q_R^{-1} = \frac{U_i^2}{Q_R}$$

- English: for fixed utility U_i, if consumption Q_R goes up, consumption Q_C must go down

Preferences, Graphically



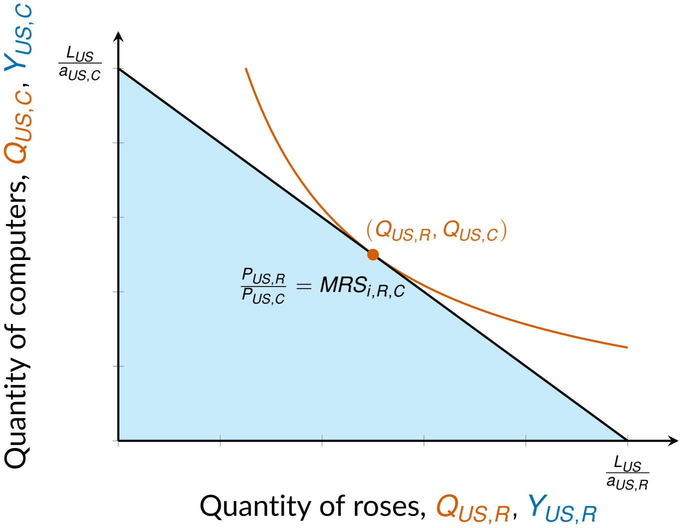
Ricardian Model: Autarky Equilibrium

- In equilibrium, relative prices = marginal rate of substitution
- Relative prices = marginal rate of substitution. Why?
- Relative prices $P_{i,R}/P_{i,C}$: marginal cost of replacing roses for computers
- Marginal rate of substitution $MU_{i,R}/MU_{i,C}$: marginal benefit of of replacing roses for computers

$$MRS_{i,R,C} = \frac{MU_{i,R}}{MU_{i,C}} = \frac{\partial U_i/\partial Q_R}{\partial U_i/\partial Q_C} = \frac{(1-\alpha_i)Q_C^{\alpha_i}Q_R^{1-\alpha_i}Q_R^{-1}}{\alpha_i Q_C^{\alpha_i}Q_R^{1-\alpha_i}Q_C^{-1}} = \frac{1-\alpha_i}{\alpha_i} \times \frac{Q_C}{Q_R}$$

- English (sort of): marginal cost = marginal benefit

Autarky Equilibrium, Graphical Example



What about Colombia?

- There are 54 million units of labor in Colombia ($L_{COL} = 54$ million)

- To produce one rose in Colombia, firms use 6 units of labor ($a_{COL,R} = 6$)

- To produce one computer in Colombia, firms use $5,400$ units of labor ($a_{COL,C} = 5,400$)

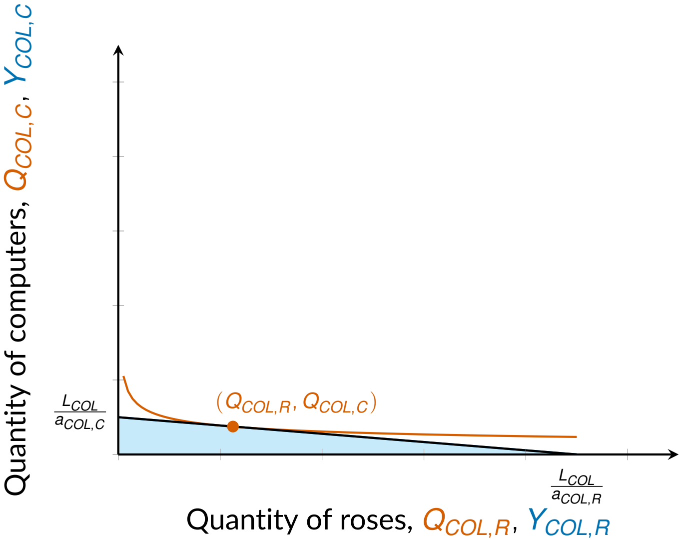
- How many units of either good can Colombia make?
  - If it fully specializes in R, it can produce $Y_{COL,R} = L_{COL}/a_{COL,R} = 54$ million$/6 = 9$ million roses.
  - If it fully specializes in C, it can produce $Y_{COL,C} = L_{COL}/a_{COL,C} = 54$ million$/5,400 = 10,000$ computers.

- In general, it can produce any combination $(Y_{COL,R}, Y_{COL,C})$ that satisfies:

$$5,400 \times Y_{COL,C} + 6 \times Y_{COL,R} \leq 54 \text{ million}$$

- Opportunity cost: $a_{COL,R}/a_{COL,C} = 6/5,400 = 1/900$.

Autarky Equilibrium, Colombia



Absolute and Comparative Advantage

- We say Colombia has an absolute advantage in the production of good p if $a_{COL,p} < a_{US,p}$
- English: absolute advantage in production = uses less labor to produce one unit
  (i.e., it is more productive)
- Opportunity cost: cost of producing a good, measured in foregone output of all others.
- Comparative advantage: An economy has a comparative advantage in producing a good if its opportunity cost of the good is lower than in the rest of the world.

Absolute and Comparative Advantage

- We say Colombia has an comparative advantage in the production of roses, since:

$$1/900 = a_{COL,R}/a_{COL,C} < a_{US,R}/a_{US,C} = 1/100$$

- We say the US has an comparative advantage in the production of computers, since:

$$900 = a_{COL,C}/a_{COL,R} > a_{US,C}/a_{US,R} = 100$$

Comparative Advantage

- Without trade, prices reflect opportunity cost:
  - In Colombia: $a_{COL,R}/a_{COL,C} = P_{COL,R}/P_{COL,C}$
  - In the US: $a_{US,R}/a_{US,C} = P_{US,R}/P_{US,C}$

- Under free trade, there are world prices, i.e. P_R, P_C that hold both in countries. Why?

  (goods are assumed to be identical)

- In this model, countries specialize in goods in which they have a comparative advantage:
  - Colombia specializes in roses if $a_{COL,R}/a_{COL,C} < P_R/P_C$
  - The US specializes in computers if $a_{US,R}/a_{US,C} > P_R/P_C$

Production Possibilities Frontier in Autarky

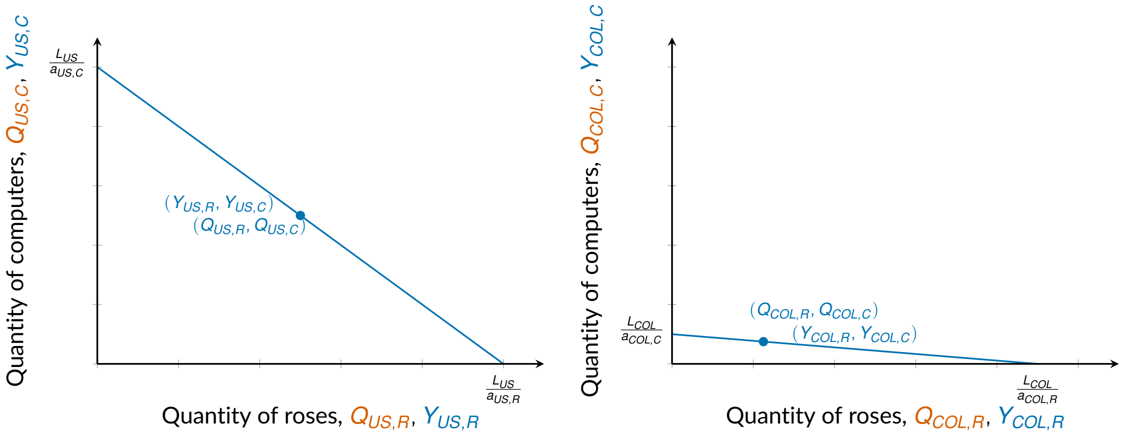


Figure: Autarky Equilibriun

Production Possibilities Frontier + Trade Prices

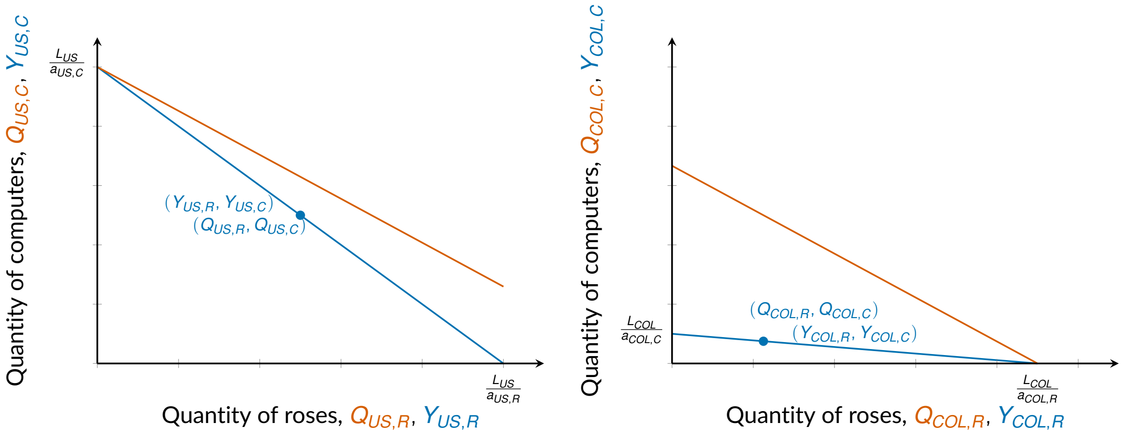


Figure: Autarky Equilibrium + Trade Prices

Production Possibilities Frontier + Trade Prices + Specialization

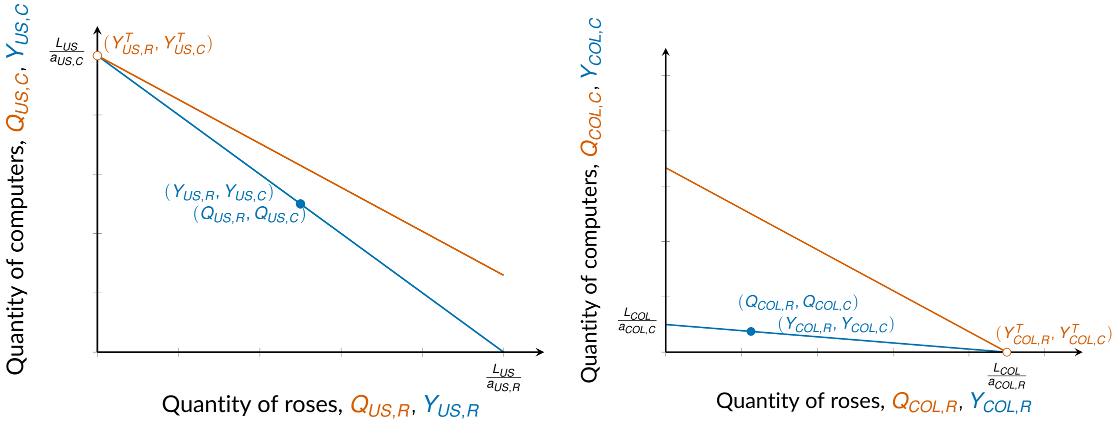


Figure: Production under Free Trade induces Specialization

Trade Equilibrium

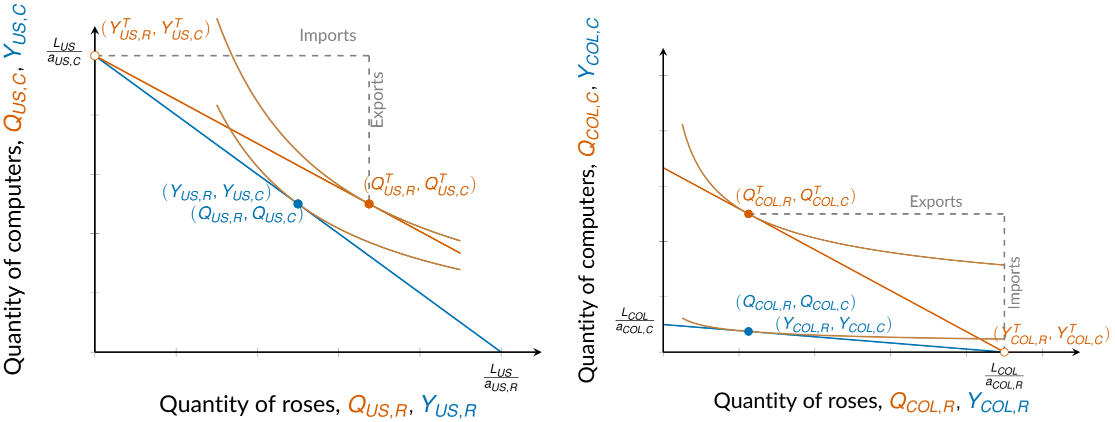


Figure: Specialization + Trade Equilibrium

Summary table

Variable	United States (US)	Colombia (COL)
Labor endowment L	300 million	54 million
Unit labor requirement for computers a_C	3,000	5,400
Unit labor requirement for roses a_R	30	6
Opportunity cost of 1 rose: $\frac{a_R}{a_C}$	$\frac{30}{3{,}000} = \frac{1}{100}$	$\frac{6}{5{,}400} = \frac{1}{900}$
Opportunity cost of 1 computer: $\frac{a_C}{a_R}$	$\frac{3{,}000}{30} = 100$	$\frac{5{,}400}{6} = 900$

Table: Labor, unit requirements, and opportunity costs