# 14.54 International Trade
## —Lecture 8: Ricardian Trade Model—

1. The Ricardian Model
   1. Setup
   2. Autarky and World Equilibria
2. Productivity, Wages, and Welfare

Small graphs on slides 7-16 were created by Marc Melitz. Used with permission.

# Introduction

- We now introduce country technologies and factors of production (aggregate factor endowments)

- ... which jointly determine the country's production possibilities frontier

- ... and the pattern of comparative advantage (assuming similar demand across countries)

- This will allow us to study:
  - How technology and factor endowments determine the pattern of comparative advantage and welfare
  - How the welfare gains of trade are shared between factors of production
  - ... and how changes in the trading environment are transmitted to the different factors

# Ricardian Model of Trade
David Ricardo: On the Principles of Political Economy and Taxation (1817)

- Emphasizes differences in technology across countries
- To keep modeling as simple as possible, a single factor of production (labor) is assumed
  - Thus, all units of labor earn the same rewards (wage)
  - Note that one can define units of labor differently across workers (skilled and unskilled)
  - However, this model cannot capture the feature that the production of different types of good may require the use of different types of labor (skilled and unskilled)
  - This model can also not address any distributional effects of trade

# Main Assumptions of Ricardian Model

- Aggregate endowment of labor
- Constant returns to scale production
    - A production technology can be summarized by a unit labor requirement: # of units of labor required to produce 1 unit of output
    - Any additional units of output are produced using same unit labor requirement
- Competitive labor and output markets
- Free movement of labor across sectors
    - In equilibrium, wages must be equalized across sectors (where production occurs)
    - Think of this as a long run equilibrium (in the short run, labor allocation across sectors may be fixed)

# Country Production Possibilities Frontier

- Technology: Let $a_{LC}$ and $a_{LF}$ denote the unit labor requirements for $C$ and $F$ production
  - Can think of $1/a_{LC}$ and $1/a_{LF}$ as the labor productivity in each sector (# units of $C$ and $F$ produced by 1 worker)
- Let $Q_C$ and $Q_F$ denote the aggregate output of $C$ and $F$
- ... and $L_C$ and $L_F$ the aggregate employment in the $C$ and $F$ sectors
- ... and $L = L_C + L_F$ the fixed labor endowment for the country
- Since $L_C = a_{LC}Q_C$ and $L_F = a_{LF}Q_F$ this aggregate labor endowment constraint can be written:

$$a_{LC}Q_C + a_{LF}Q_F = L$$
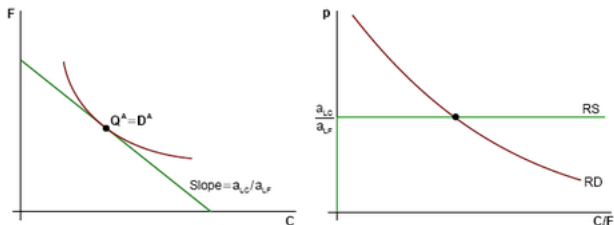
which summarizes the country's PPF

# Country Production Possibilities Frontier (Cont.)

- Recall the PPF: $a_{LC} Q_C + a_{LF} Q_F = L$
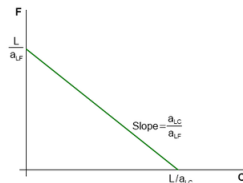


- Note how increases in productivities $1/a_{LC}$ or $1/a_{LF}$ and country size $L$ shift out this PPF
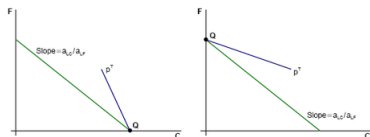
# Autarky Equilibrium



- Autarky price $p_A = a_{LC}/a_{LF}$ is determined by the relative supply

# Trade Equilibrium at Given Trade Price



- If $p^T > a_{LC}/a_{LF}$ then specialize in $C$
- If $p^T < a_{LC}/a_{LF}$ then specialize in $F$
- If $p^T = a_{LC}/a_{LF}$ then any production on the PPF maximizes the value of revenue
- Gains from trade so long as $p^T \neq p^A = a_{LC}/a_{LF}$ (as in standard model)

# Technology and Comparative Advantage

- Consider 2 countries (Home & Foreign) such that
  $a_{LC}^*/a_{LF}^* > a_{LC}/a_{LF}$
- Note that this implies that Foreign is relatively more productive in $F$ than Home
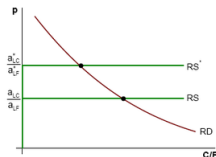


- Then Foreign has a comparative advantage in $F$ and Home in $C$
- Note that country size ($L$ and $L^*$) and absolute productivity do not affect the pattern of comparative advantage!

- If $p^T < a_{LC}/a_{LF}$ then both countries specialize in $F$
- If $p^T > a_{LC}^*/a_{LF}^*$ then both countries specialize in $C$
- If $a_{LC}/a_{LF} < p^T < a_{LC}^*/a_{LF}^*$ then countries specialize according to comparative advantage
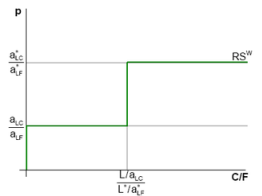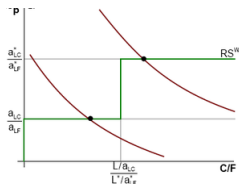
# Determination of Equilibrium Trade Price

- $p^T < a_{LC}/a_{LF}$ and $p^T > a_{LC}^*/a_{LF}^*$ cannot be equilibrium prices for the world
- Typical case is complete specialization according to comparative advantage with equilibrium $p^T$
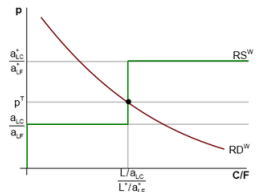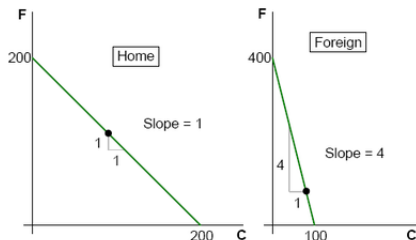
# Determination of Equilibrium Trade Price (Cont.)

- However, incomplete specialization is also possible where
  $p^T = a_{LC}/a_{LF}$ or $p^T = a^*_{LC}/a^*_{LF}$



- This is most likely to happen when one country is very large (in terms of size or productivity) relative to the other
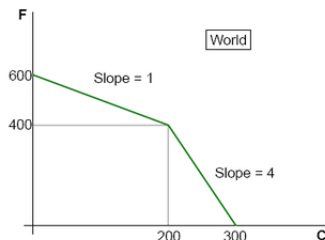- The bigger country will then be incompletely specialized

# Constructing the World PPF

- Consider the following example:
  - Home: $L = 1200$, $a_{LC} = 6$, $a_{LF} = 6$
  - Foreign: $L = 400$, $a_{LC}^* = 4$, $a_{LF}^* = 1$
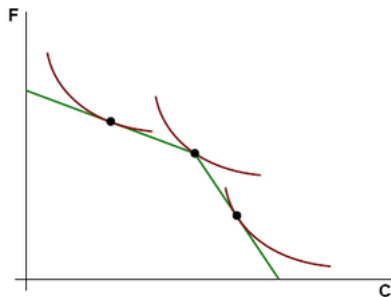
- Consider the following example:
  - Home: $L = 1200$, $a_{LC} = 6$, $a_{LF} = 6$
  - Foreign: $L = 400$, $a_{LC}^* = 4$, $a_{LF}^* = 1$

# Equilibrium on the World PPF

(Assuming same preferences in both countries)

# Productivity and Wages

- Competitive labor and output markets
  - Firms pay workers the value of their marginal product:
  - If $C$ is produced, workers in $C$ sector are paid $w_C = p_C / a_{LC}$
  - If $F$ is produced, workers in $F$ sector are paid $w_F = p_F / a_{LF}$
  - With just one production factor, this is equivalent to marginal cost pricing

- As workers can freely move to sector with higher wage (this is the long run), then must have $w = w_C = w_F$ whenever both $C$ and $F$ are produced
  - This implies $p_C / p_F = a_{LC} / a_{LF}$ whenever both $C$ and $F$ are produced
  - ... as in the case in autarky (and any other incomplete specialization outcome under trade)

- If country is specialized in good $i = \{C, F\}$ then wages are $w = p_i / a_{Li}$

## Productivity and Wages: Complete Specialization

- Another interpretation for complete specialization:
  - Consider the trade equilibrium where $p^T > a_{LC}/a_{LF}$ and country specializes in $C$
  - Why is there no $F$ production?
  - Workers in $C$ sector are paid

$$w = \frac{p_C^T}{a_{LC}} = \frac{a_{LF}}{a_{LC}} \frac{p_C^T}{p_F^T} \frac{p_F^T}{a_{LF}} > \frac{p_F^T}{a_{LF}}$$

  - To be paid the same wages as in the $C$ sector, workers in the $F$ sector would have to be paid more than the value of their marginal product $p_F^T/a_{LF}$
  - In other words, it is always cheaper to import $F$ at price $p_F^T$ then to produce it at a cost of $wa_{LF} > p_F^T$ per unit

# Ricardian Trade and Relative Wages (Across Countries)

- Assume that 2 countries are open to trade at the relative price $p^T$
- ... and both countries are completely specialized (in $C$ for Home, in $F$ for Foreign): $a_{LC}/a_{LF} < p^T < a_{LC}^*/a_{LF}^*$
- Then $w = p_C^T/a_{LC}$ and $w^* = p_F^T/a_{LF}^*$ and

$$\frac{w}{w^*} = \frac{p_C^T}{p_F^T}\frac{a_{LF}^*}{a_{LC}} = p^T\frac{a_{LF}^*}{a_{LC}}$$

  The relative wage (across countries) is determined by the terms of trade and the absolute productivity advantage between the two countries (in the good that is produced in each country)

- In an economy with just one factor where these factors face the same prices $p_C^T$ and $p_F^T$, this relative wage $w/w^*$ is also a measure of relative welfare
- There are the standard gains/losses from changes in the terms of trade (holding technology fixed)

# Productivity and Welfare

- Note that absolute productivity determines differences in welfare across countries whereas relative productivity determines the pattern of trade (comparative advantage)

- However, gains from trade are independent of differences in absolute productivity

- In an equilibrium with trade, increases in absolute productivity typically generate welfare gains to both countries:
  - Direct welfare gains to the country with increased productivity
  - Indirect welfare gains via the terms of trade to the trade partners

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