14.54 International Trade
— Lecture 8: Ricardian Trade Model —
Today’s Plan

1. The Ricardian Model
   1. Setup
   2. Autarky and World Equilibria

2. Productivity, Wages, and Welfare

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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
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 $p_A = \frac{a_{LC}}{a_{LF}}$ 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)
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!
Pattern of Specialization and World Relative Supply

- If $p^T < a_{LC} / a_{LF}$ then both countries specialize in $F$
- If $p^T > a^*_C / a^*_F$ then both countries specialize in $C$
- If $a_{LC} / a_{LF} < p^T < a^*_C / a^*_F$ 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 $p^T$.
However, incomplete specialization is also possible where
\[ p^T = a_{LC} / a_{LF} \text{ or } p^T = a_{LC}^* / a_{LF}^* \]

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.
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 $w = p_i / a_{Li}$
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

\[
W = \frac{p^T_C}{a_{LC}} = \frac{a_{LF}}{a_{LC}} \frac{p^T_C}{p^T_F} \frac{p^T_F}{a_{LF}} > \frac{p^T_F}{a_{LF}}
\]

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 \( p^T_F / a_{LF} \).

In other words, it is always cheaper to import \( F \) at price \( p^T_F \) then to produce it at a cost of \( w a_{LF} > p^T_F \) 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 $w = p^T_C / a_{LC}$ and $w^* = p^T_F / a^*_{LF}$ and

$$\frac{w}{w^*} = \frac{p^T_C}{p^T_F} \frac{a^*_{LF}}{a_{LC}} = p^T \frac{a^*_{LF}}{a_{LC}}$$

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 $p^T_C$ and $p^T_F$, 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