Lecture 2: Technological Differences: Ricardian Models

14.581: International Economics I

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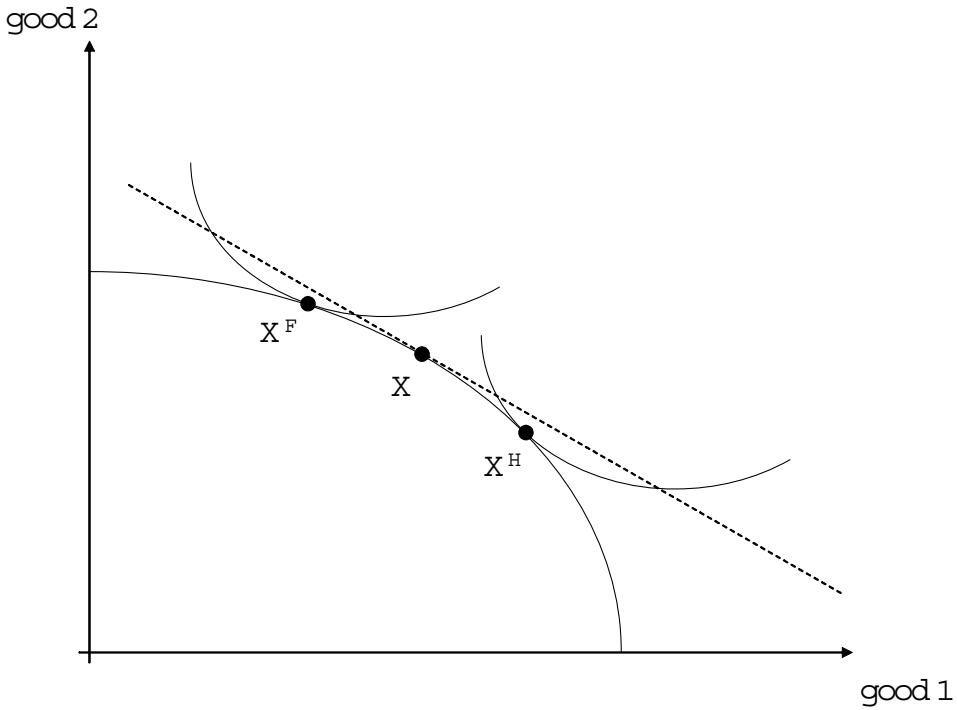
What Determines Autarky Prices?

- Our treatment of the basic law of comparative advantage highlighted the role of differences in autarky prices in the determination of trade patterns and trade volumes.
  - with $p^{Ak} = p^A$ for all k, we have no trade
- Following general equilibrium theory, we can identify three fundamental sources of autarky price differences across countries:
  1. Differences in tastes
  2. Differences in technologies
  3. Differences in endowments
- Caveat: since most trade seems to flow between similar countries, it may seem that emphasizing cross-country differences is a non-starter.
  - Still, neoclassical trade theories provide valuable insights into the structure of trade flows and are an essential benchmark for more realistic models.

Taste Differences

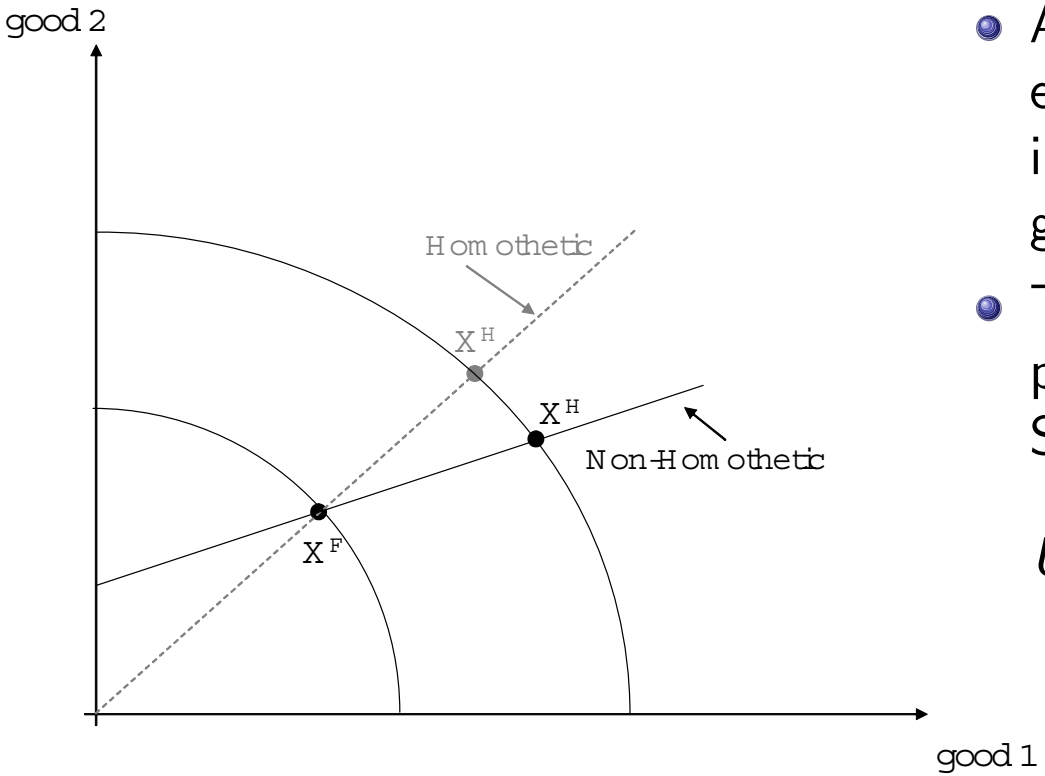
- Preferences may shape comparative advantage if (i) preferences themselves differ across countries, or (ii) preferences are identical worldwide but non-homothetic.
- An example of (i) is illustrated below. Both countries share the same endowments and technologies, but country H shows a relative preference for good 1, and consequently p_1^A / p_2^A is higher there.



- As illustrated in the figure, in a trading equilibrium country H will import good 1 and export good 2.

Taste Differences (cted.)

- Now consider an example with non-homothetic preferences. Preferences are such that the income elasticity is larger (lower) than one for good 1 (2). Because H is richer, its demand pattern is tilted towards good 1 and again p_1^A / p_2^A is higher there.



- As before, in a trading equilibrium country H will import good 1 and export good 2.
- The figure corresponds to preferences of the Stone-Geary type:

$$U = \alpha \log c_1 + \beta \log (c_2 - b)$$

Taste Differences (cted.)

- The literature has largely downplayed the role of preferences in shaping comparative advantage. This is for at least two reasons:
  1. One can generate any trade pattern with arbitrary differences in preferences.
  2. The theory predicts that a country should import goods for which there is a disproportionately large demand (which is counterfactual).
- Still, the literature has produced interesting contributions highlighting the role of non-homotheticities in shaping trade flows. See Linder (1961), Markusen (1986), Flam and Helpman (1987), Hunter (1991), Stokey (1991), or Matsuyama (2000).

Technological Differences: Ricardo's Insight

- Consider a world with 2 countries (H and F), two goods and one factor of production, labor.
- Technology is summarized by four unit input requirements: a_i^k for $k = H, F$, $i = 1, 2$.

Theorem

Country H will be a net exporter of good 1 if and only if $\frac{a_1^H}{a_2^H} < \frac{a_1^F}{a_2^F}$, that is, if and only if H has comparative advantage in good 1.

Proof.

Assume prices lie on the unit simplex. Because labor is the only factor,

$$p_i^{Ak} = \frac{a_i^k}{\sum_\ell a_\ell^k}.$$

Now note that $p_1^{AH} < p_1^{AF} \iff a_1^H / a_2^H < a_1^F / a_2^F$. But from Lecture 1, this implies $M_1^H < 0$. □

A Fully-Fledged Ricardian Model

- How does Ricardo's insight extend to a world with many goods? We next discuss the highly tractable continuum version developed by Dornbush, Fischer and Samuelson (1977).
- **Environment and Endowments:** There are two countries (H and F) and a continuum of goods, $i \in [0,1]$ produced with labor. Denote the endowments of labor by L^H and L^F. All markets are perfectly competitive.
- **Technology:** Unit output labor requirements for good i in country $k = H, F$ are given by $a^k(i)$. Without loss of generality we can index goods such that

$$A(i) = \frac{a^F(i)}{a^H(i)}$$

  is a decreasing function of i.
- **Preferences:** Assume identical Cobb-Douglas preferences in both countries with a share $b(i)$ of income going to good i. Let $\int_0^1 b(i) = 1$.

Equilibrium of the D-F-S Model

- The cost of producing good i in country k is given by $w^k a^k(i)$. Perfect competition will ensure that good i be produced in H if and only if $w^H/w^F \leq A(i)$, or if and only if $i \leq \widehat{i}$, where $\widehat{i}$ is such that

$$w^H/w^F = A\left(\widehat{i}\right). \tag{1}$$

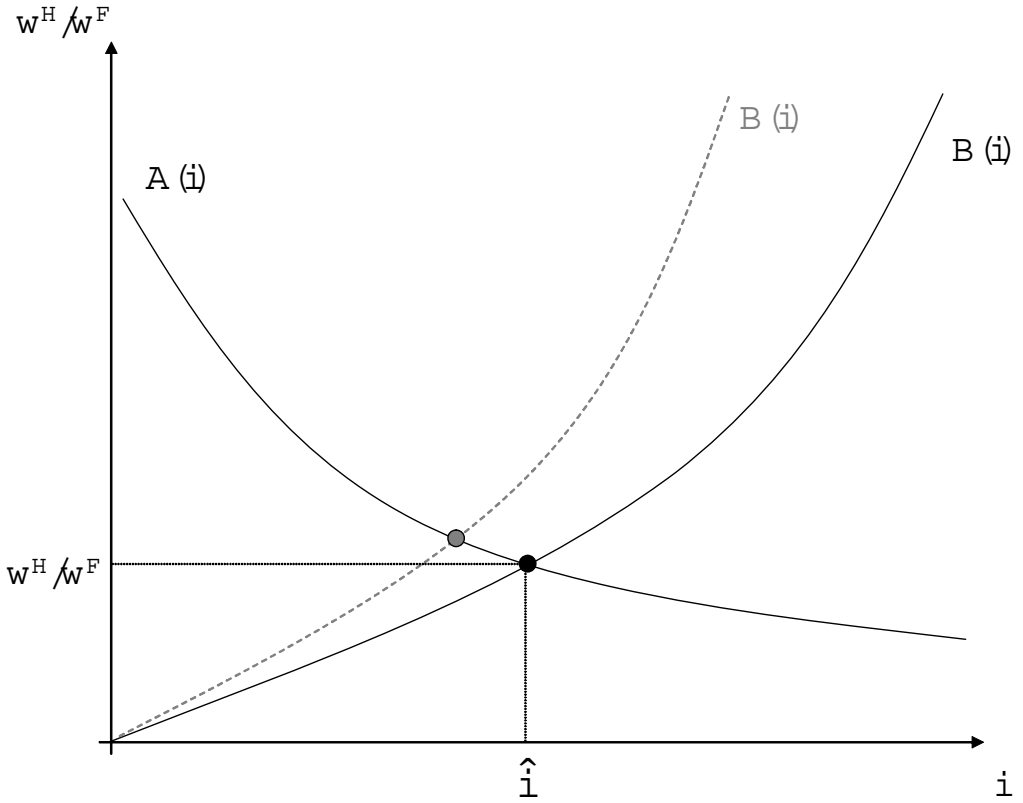
- We next appeal to balanced trade to close the model. Since the equilibrium features no profits, defining $\vartheta\left(\widehat{i}\right) = \int_0^{\widehat{i}} b(i)\,di$, we have $w^F L^F \vartheta\left(\widehat{i}\right) = w^H L^H\left(1-\vartheta\left(\widehat{i}\right)\right)$, or simply

$$\frac{w^H}{w^F} = \frac{\vartheta\left(\widehat{i}\right)}{1-\vartheta\left(\widehat{i}\right)}\frac{L^F}{L^H} \equiv B\left(\widehat{i}\right). \tag{2}$$

- Equations (1) and (2) define a system of two equations in two unknowns, $\widehat{i}$ and w^H/w^F.

Graphical Illustration

- The figure below illustrates the equilibrium. Remember that the curve $A(i)$ is monotonically decreasing in i. On the other hand, $\vartheta'\left(\widehat{i}\right) > 0$, and thus $B(i)$ is monotonically increasing in i. But note also that $B(0) = 0$ and $\lim_{i \to 1} B(i) = +\infty$. Hence, an equilibrium exists and is unique.



Gains from Trade

- Consumption under autarky is

$$c^H(i) = \frac{b(i) w^H L^H}{p^H(i)} = \frac{b(i) L^H}{a^H(i)} \text{ for all } i.$$

- Consumption under free trade is

$$c^H(i) = \frac{b(i) w^H L^H}{p(i)} = \begin{cases} \frac{b(i) L^H}{a^H(i)} & \text{if} \quad i \leq \widehat{i} \\ \frac{w^H / w^F}{a^F(i)} b(i) L^H & \text{if} \quad i > \widehat{i} \end{cases}, \tag{3}$$

but $\frac{w^H / w^F}{a^F(i)} > \frac{1}{a^H(i)}$ for $i > \widehat{i}$ and thus welfare is strictly higher (H is increasing its real consumption of the goods it is importing).

Comparative Statics: Population Growth

- Suppose that population in F increases. From the point of view of H, you can interpret this as trade integration with a large South.
- As illustrated in the Figure above, this leads to a fall in the set of goods produced in H (H "loses" industries), but to an increase in the relative wage in H.
- It is easy to see that H will be better off. Real consumption for the set of goods produced in H before and after the rise in L^F is unaffected, while it raises for all goods that are imported (see equation 3).
- On the other hand, consumption per capita in F is given by

$$c^F(i) = \frac{b(i)\, w^F}{p(i)} = \begin{cases} \frac{b(i)}{a^F(i)} & \text{if} \quad i > \widehat{i} \\ \frac{w^F / w^H}{a^H(i)} b(i) & \text{if} \quad i \leq \widehat{i} \end{cases}, \tag{4}$$

  from which we can conclude that workers in F will be worse off.
- Note that with technology being fixed, there is a one-to-one mapping between changes in the terms-of-trade (relative wages) and changes in welfare.

Comparative Statics: Neutral Technological Improvement

- Suppose that all unit labor requirements in F by a factor α. Then $A(j)$ declines by the same factor of proportionality α. As a result, the relative wage w^H/w^F and the threshold $\widehat{i}$ both fall.
  - But note that w^H/w^F falls by a factor lower than α.
- Working with equation (3), one can easily verify that H benefits from the technological improvement in F despite losing comparative advantage in certain goods and despite the deterioration in its terms of trade – import prices still fall for all goods $i > \widehat{i}$.
- On the other hand, from (4) we can also conclude that F will be better off.
- The fact that the technological improvement is neutral is however important (see Problem Set 1).
- The fact that preferences are homothetic is also important (see Matsuyama, 2000).

D-F-S and the Gravity Equation

- It is interesting to note that using equations (1) and (2), we can express bilateral exports between H and F as

$$w^F L^F \vartheta\left(\widehat{i}\right) = \frac{\left(w^H L^H\right)\left(w^F L^F\right)}{w^F L^F + w^H L^H} = \frac{Y^H Y^F}{Y^W},$$

  where Y denotes GDP.
- Hence, the D-F-S model predicts a simplified version (with no trade frictions) of the so-called gravity equation, which has been shown to hold remarkably well in the data.
- But this is not surprising. It can easily be shown that *any* model with complete specialization, homothetic preferences, and no trade barriers delivers this prediction.

D-F-S and and Iceberg Transport Costs

- Following Samuelson (1954) assume that if a unit of a good is shipped, only a fraction g of the good gets lost in transit.
- Now H will be able to export only those goods for which $w^H/w^F \leq A(i)\,g$, while F will be able to export only those goods for which $w^H/w^F \geq A(i)/g$. This defines two thresholds, $\widehat{i}^H$ and $\widehat{i}^F$, with $\widehat{i}^H < \widehat{i}^F$. Hence, there is now a range of endogenously nontradable goods.
- We can again close the model appealing appeal to balanced trade:

$$w^F L^F \vartheta\left(\widehat{i}^H\right) = w^H L^H \left(1 - \vartheta\left(\widehat{i}^F\right)\right).$$

- **Transfer problem:** Suppose H makes a transfer $w^H T$ to F. Then

$$\frac{w^H}{w^F} = \frac{\vartheta\left(\widehat{i}^H\right)}{1-\vartheta\left(\widehat{i}^F\right)}\frac{L^F}{L^H} - \frac{\left(\vartheta\left(\widehat{i}^F\right) - \vartheta\left(\widehat{i}^H\right)\right)}{1-\vartheta\left(\widehat{i}^F\right)}\frac{T}{L^H}\frac{w^H}{w^F},$$

and thus H's terms of trade deteriorate (Keynes' "orthodox" view).