International Economic Issues

The Ricardian Model

Chahir Zaki

chahir.zaki@feps.edu.eg
Classic Trade Theory

- Ricardian Model - Technological Comparative Advantage:
  - Basic 2 Good Ricardian model (Feenstra, Chapter 1)
  - Continuum of Goods (Dornbush, Fischer and Samuelson, 1977)

- Heckscher-Ohlin Factor Endowment Model:
  - 2 Good 2 Factor Model (Feenstra, Chapters 1)
  - Stolper Samuelson
  - Leontief Paradox

- Heckscher-Ohlin-Vanek Model and Tests of HO theory
Outline

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  – Autarky
  – Trade
• Empirics
  – Bernhofen and Brown (2004)
  – Costinot and Donaldson (2012)
• Conclusion
  – Misconceptions
  – Summary
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Introduction

Basic question in international trade:
– Why do countries trade?
• Basic answer:
  – Because countries are different
  – They have different “abilities” to produce different goods
  – They could be better off producing only a subset of goods and importing the others
• Specialization process Very similar to Adam Smith’s principle of division of work (based on increasing returns to scale)
Introduction

• Which kind of difference matters?
  – If a foreign country is better than Home in the production of a given good, it’s worth importing this good rather than producing it.
  – But what appends if the Home country is better at making all good?
  – Well, if home is substantially better in one production and only slightly better in one other, there is still some gains to produce relatively more of the first good.
Comparative Advantage and Opportunity Cost

• The Ricardian model uses the concepts of *opportunity cost* and *comparative advantage*.

• The opportunity cost of producing something measures the cost of not being able to produce something else.
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2 X 2 X 1 model: Autarky

- $a_i =$ Labor needed to produce one unit of good $i$ at Home
- $a^*i =$ Labor needed to produce one unit of good $i$ in the Foreign country
- $L$ and $L^*$ are the total labor forces in H and F countries.
- Labor cannot migrate, but it is perfectly mobile between industries

*a country produces both goods if and only if wages earned in the two industries are the same.*
- Since $1/a_i$ is the marginal product of labor: $w_i = p_i/a_i$
- Hence, a country produces both goods if: $p_1/a_1 = p_2/a_2$
  $p = p_1/p_2 = a_1/a_2$
Autarky: Home country

Possibility frontier (PPF)

• With all labor devoted to industry $i$, the Home country can produce $L/a_i$
• The PPF traduces the full employment equilibrium: $L = y_1a_1 + y_2a_2$
  \[
y_2 = \frac{L}{a_2} - \left(\frac{a_1}{a_2}\right)y_1
\]
• The slope is $a_1/a_2 = p$
• Considering a set of indifference curves, consumption in autarky occurs in point A
Autarky

Home PPF

Foreign PPF

$L$ is labor endowment
$A$ is consumption point
$y_i$ is the output of industry $i$
$p^a$ is the autarchy price
Autarky

If the Home country as a comparative advantage in producing good 1:
– The relative cost of producing 1 is lower:
\[ \frac{a_1}{a_2} < \frac{a^{*1}}{a^{*2}} \]
– Then, the relative price of 1 is lower in H in autarky \( p < p^* \)
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Trade

- Lower relative prices of good 1 in country H is an incentive to trade:
  - Country F is likely to import good 1 (relatively cheap abroad) against good 2 (relatively expensive abroad)
  - Inversely Country H is likely to import good 2 and export good 1.
Prices

What is the equilibrium price $p$ at which world supply equals world demand?

- If $p < \frac{a_1}{a_2}$ then: $p < p_a < p_{a^*}$
  Good 2 pays relatively more than it costs in all countries (it is worth selling good 2 against good 1).
  both countries are fully specialized in good 2.
- If $p > \frac{a^*_1}{a^*_2}$ then: $p_a < p_{a^*} < p$
  both countries are fully specialized in good 1.
- If $p_a < p < p_{a^*}$
  Country H produces good 1 and country F produces good 2.
World Relative Supply and Demand

Relative Supply

Relative Demand

\[ p \]

\[ p^a \]

\[ p^a^* \]

\[ p^e \]

\[ (L/a_1)/(L^*/a_2^*) \]

\[ (y_1+y_1^*)/(y_2+y_2^*) \]
Here the demand for good one is high enough that the equilibrium price of trade is equal to the autarchy foreign price.

Foreign is no better off with trade. When might this occur?
Here the trade price of good one is higher than in autarky at home, and lower than in autarchy in foreign.

Both countries can gain from trade, and will fully specialize in their comparative advantage.
Points B and B* represent the level of production of goods 1 and 2 in each country under specialization. C and C* are consumption in home and foreign.

With \( p_a < p < p^a \):
- In country H, the opportunity cost of producing good 1 is lower than its relative price (e.g., it's worth stopping the production of good 2 in order to produce more good 1 and trade it against good 2).
Country H is fully specialized in good 1
Country F is fully specialized in good 2
Total Specialization

• Both countries are better off under free trade: they can obtain a consumption point above their PPF

• If a country stays diversified, prices don’t change welfare doesn’t change. The other country has the highest possible gain
Comparative advantage and Wages
(Feenstra pg. 4 note 2)

• Suppose Home has a comparative advantage in good 1.
  \[ \frac{a_1}{a_2} < \frac{a_1^*}{a_2^*} \]
  and an absolute disadvantage in both goods.
  • \[ a_1 > a_1^* \]
  • \[ a_2 > a_2^* \]

• In Free Trade suppose each country specializes \( (p^a < p < p^{a*}) \)
  - workers at home produce good 1 and earn \( w = \frac{p}{a_1} \)
  - workers in foreign produce good 2 earn \( w^* = \frac{1}{a_2^*} \)

• \[ p = \frac{a_1}{a_2} < \frac{a_1^*}{a_2^*} \], rearranging: \[ \frac{1}{a_2^*} > \frac{p}{a_1^*} \]

• We assumed \( a_1 > a_1^* \), resulting in \( \frac{p}{a_1^*} > \frac{p}{a_1} \)
• Wages in Foreign, \( w^* = \frac{1}{a_2^*} > \frac{p}{a_1^*} \Rightarrow \frac{p}{a_1} = w \)
Comparative advantage and Wages

– Trade still occurs according to comparative advantages
– Home country can export good 1, despite that its cost in terms of labor input is higher than abroad... because wages are lower.
– Trade patterns are determined by comparative advantage
– The level of wages across countries is determined by absolute advantage
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Empirical Evidence

• Do countries export those goods in which their productivity is relatively high?

• The ratio of US to British exports in 1951 compared to the ratio of US to British labor productivity in 26 manufacturing industries suggests yes.

• At this time the US had an absolute advantage in all 26 industries, yet the ratio of exports was low in the least productive sectors of the US.
Empirical Evidence (cont.)

**Figure 3-6**

**Productivity and Exports**

A comparative study showed that U.S. exports were high relative to British exports in industries in which the United States had high relative labor productivity. Each dot represents a different industry.
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Testing Ricardo

• It requires to compare autarky relative prices or relative productivity in all industries.
• ... But autarky situations are rarely observed:
• – Exception = Bernhofen and Brown who study the natural experience of Japanese sudden trade liberalization in the 1860s.
Testing Ricardo

• They exploit Japan's sudden and complete opening up to international trade in the 1860s to test the empirical validity of Ricardo’s proposition.

• Historical evidence supports the assertion that the characteristics of the Japanese economy at the time were compatible with the key assumptions of the neoclassical trade model.

• Using detailed product-specific data on autarky prices and trade flows, they found that the autarky price value of Japan's trade is negative for each year of the period 1868-75. This confirms the prediction of the theory.
Japan's regimes

(autarky) regime A: \((p_1^a, x_1^a, c_1^a), x_1^a \in F_1,\)

(autarky) regime B: \((p_2^a, x_2^a, c_2^a), x_2^a \in F_2,\)

(free-trade) regime C: \((p_2^f, x_2^f, c_2^f), x_2^f \in F_2.\)

\[
p_2^fc_2^f \geq p_2^fc_2^a \Rightarrow p_2^ac_2^f > p_2^ac_2^a, \quad (2)
\]

Lemma. Law of comparative advantage.—The value of net exports in period 2, evaluated at the (unobserved) autarky prices in period 2, is negative: \(p_2^aT < 0.\)

Proof. Expressions (1) and (3) imply that \(p_2^fc_2^f = p_2^fx_2^f \geq p_2^ax_2^a = p_2^fc_2^a.\) From (1) and (2), we then obtain \(p_2^ac_2^f > p_2^ac_2^a = p_2^ax_2^a \geq p_2^ax_2^f \Rightarrow p_2^aT < 0.\)
Japan: A Natural Experiment
• This figure illustrates the price changes of the key tradable goods after the opening up to trade. It presents a scatter diagram of the net exports in 1869 graphed in relation to the change in prices from 1851-53 to 1869.

• The prices of major exports such as products of the silk industry (silk and silk worm eggs) and minor exports such as copper manufactures, sake, and vegetable wax all increased; in some cases they almost doubled. The relative price of key imports such as sugar, cotton cloth, cotton yarn, and iron products displayed substantial declines.
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Costinot and Donaldson (AER, 2012)

• The problem: the key explanatory variable in Ricardo’s theory, i.e. relative labor productivity, cannot be directly observed because we do not observe British workers in the wine industry.
Costinot and Donaldson (AER, 2012)

The solutions:

1. Make explicit assumptions on the distribution function of productivities across different economic activities. Then, unobserved productivity might be inferred (cf. Costinot et al. RES 2012).

2. Focus on a specific factor for which productivity might be measured independently of the use of the factor. Costinot and Donaldson use the second solution.
Costinot and Donaldson (AER, 2012)

• They argue that:

“Land (and thus agricultural goods) is a good candidate because agronomists are able to predict how productive is a given parcel of land, considering the nature of the soil, the climatic conditions”
The model considers:

- $C$ countries
- $G$ goods (crops)
- $F$ factors of production (a parcel of land).

Of course, the factors of productions are immobile across countries, but can be used for producing any kind of crops.

- $A_{cf}^g$ is the (exogenous) productivity of land $f$, in country $c$ when producing the crop $g$.
- $L_{cf}^g$ is the quantity of factor $f$ allocated to good $g$ in country $c$. 

Costinot and Donaldson (AER, 2012)
Costinot and Donaldson (AER, 2012)

• The variation in $A_{cf}^g$ is the source of the comparative advantages
• For example: if two factors $f1$ and $f2$ located in country $c$ are such that:

$$\frac{A_{cf_2}^g}{A_{cf_2}^g} > \frac{A_{cf_1}^g}{A_{cf_1}^g}$$

• then, $f1$ is relatively less productive than $f2$ in the production of good 2 and relatively more in the production of good 2.
• Therefore, the piece of land $f2$ has a comparative advantage in the production of good 2.
Costinot and Donaldson (AER, 2012)

- The comparative advantages determine the optimal allocation of land across the products... and thus the level of production.
- **Optimal allocation:** A land will be used in the production of a good $g$ if the value of the output of $g$ that is generated, (i.e. Productivity $X$ Price) is larger than the value of output generated by an alternative production.

\[
\widetilde{F}_c^g = \left\{ f = 1, \ldots, F \mid \frac{A_{cf}^g}{A_{cf}^{g'}} > \frac{p_{g'}}{p_c^g} \text{ if } g' \neq g \right\}
\]
Costinot and Donaldson (AER, 2012)

• The test will consist to compute the production of each crop in each country \( Q_c^g \), predicted by the model, using data on land productivity and commodity prices and then, to compare it to actual output levels, \( \overline{Q_c^g} \)

• **Data:**

• FAO provides, for 55 countries and 17 crops:
  – Actual outputs levels \( \overline{Q_c^g} \)
  – Producer prices \( P_c^g \)
  – The Global Agro Ecological Zone provides information on \( A_{cf}^g \)
Costinot and Donaldson (AER, 2012)

Table 1: Comparison of Predicted Output to Actual Output

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>log (output)</th>
<th>log (predicted output)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
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<tr>
<td>log (predicted output)</td>
<td>0.212***</td>
<td>0.244***</td>
<td>0.096**</td>
<td>0.143**</td>
<td>0.273***</td>
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<td>(0.074)</td>
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<td>all</td>
<td>major countries</td>
<td>major crops</td>
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</tbody>
</table>
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Ricardian Model: Main Lessons

• Trade occurs because technology varies from country to country
• Advanced countries can gain from trade even if their workers have to compete with “cheap labor” countries
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Misconceptions About Comparative Advantage

1. Free trade is beneficial only if a country is more productive than foreign countries.
   – But even an unproductive country benefits from free trade by avoiding the high costs for goods that it would otherwise have to produce domestically.
   – High costs derive from inefficient use of resources.
   – The benefits of free trade do not depend on absolute advantage, rather they depend on comparative advantage: specializing in industries that use resources most efficiently.
2. Free trade with countries that pay low wages hurts high wage countries.

   – While trade may reduce wages for *some* workers, thereby affecting the distribution of income within a country, trade benefits consumers and other workers.

   – Consumers benefit because they can purchase goods more cheaply (more wine in exchange for cheese).

   – Producers/workers benefit by earning a higher income (by using resources more efficiently and through higher prices/wages).
3. Free trade exploits less productive countries.

- While labor standards in some countries are less than exemplary compared to Western standards, they are so with or without trade.

- Are high wages and safe labor practices alternatives to trade? Deeper poverty and exploitation (e.g., involuntary prostitution) may result without export production.

- Consumers benefit from free trade by having access to cheaply (efficiently) produced goods.

- Producers/workers benefit from having higher profits/wages—higher compared to the alternative.
Transportation Costs and Non-traded Goods

- The Ricardian model predicts that countries should completely specialize in production.
- But this rarely happens for primarily 3 reasons:
  1. More than one factor of production reduces the tendency of specialization (chapter 4)
  2. Protectionism (chapters 8–11)
  3. Transportation costs reduce or prevent trade, which may cause each country to produce the same good or service
Transportation Costs and Non-traded Goods (cont.)

- Non-traded goods and services (e.g., haircuts and auto repairs) exist due to high transportation costs.
  - Countries tend to spend a large fraction of national income on non-traded goods and services.
  - This fact has implications for the gravity model and for models that consider how income transfers across countries affect trade.
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Conclusion

1. A country has a comparative advantage in producing a good if the opportunity cost of producing that good is lower in the country than it is in other countries.
   - A country with a comparative advantage in producing a good uses its resources most efficiently when it produces that good compared to producing other goods.

2. The Ricardian model focuses only on differences in the productivity of labor across countries, and it explains gains from trade using the concept of comparative advantage.

3. When countries specialize and trade according to the Ricardian model; the relative price of the produced good rises, income for workers rises and imported goods are less expensive for consumers.
Conclusion

4. Trade is predicted to benefit both high productivity and low productivity countries, although trade may change the distribution of income within countries.

5. High productivity or low wages give countries a cost advantage that allow them to produce efficiently.

6. Although empirical evidence supports trade based on comparative advantage, transportation costs and other factors prevent complete specialization in production.
Conclusion

• The key characteristics are:
  – Perfect competition (not that important)
  – Comparative advantages based on productivity differences
• Unique factor that generates complete specialization
• Of course, perfect competition does not really exist, and complete specialization is a quite strong conclusion...
• However, it seems reasonable to consider that international difference in productivities plays an important role in international trade.
References

• Feenstra, Chapter 1.
• Matthieu Crozet lectures.
• Bernhofen and Brown (2004)
• Costinot and Donaldson (2012)