

The Ricardian (Comparative Advantage) Model of International Trade (*MODIFIED*)

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► Last time

- You should care about international economics because:
 1. Denmark is small, world is large
 2. Lots of popular misconceptions
 3. Still many puzzles and counter-intuitive ideas
- Gravity model:
 1. Trade proportional to product of partner sizes
 2. Trade falls with distance, geographic and cultural
- Gravity model for some reason describes trade flows well
- Distance costs still seem unreasonably large

- ▶ Last time: Ricardo
- ▶ Basic model:
 1. The parable of my RA's
 2. Who makes what?
- ▶ Analysis of model results
 1. Specialization and gains
 2. Wages and productivity
 3. Extensions

- ▶ Today: More Gravity and Ricardo

- ▶ Gravity

1. A puzzle
2. Where does gravity come from?

- ▶ Ricardo

- ▶ Review
 - ▶ Ricardo with many goods
 - ▶ Ricardo with factor movement
 - ▶ Confronting the data
 - ▶ Common misunderstandings
 - ▶ Limitations of Ricardo
 - ▶ If time: a numerical example

Section 1: Gravity again

The gravity equation

- ▶ Gravity equation (gravity):

$$F_{ij} = g \frac{M_i M_j}{d_{ij}^2}$$

- ▶ Gravity equation (trade):

$$X_{ij} = g \frac{\text{GDP}_i \text{GDP}_j}{d_{ij}^\theta}$$

- ▶ typically $\theta \approx 1$
- ▶ Empirical fact first observed by Tinbergen in 1960's.

Puzzle

- ▶ Gravity equation (trade):

$$X_{ij} = g \frac{\text{GDP}_i \text{GDP}_j}{d_{ij}^\theta}$$

- ▶ typically $\theta \approx 1$
- ▶ What happens to trade if the economy of every country doubles?

- ▶ Denmark's export to GDP ratio is about a third
 - ▶ Recently world GDP doubles every 30 years
 - ▶ According to gravity, what will Denmark's export to GDP ratio look like in 60 years?
-
- ▶ Theoretical problem with the gravity model
 - ▶ Why not in physics?

Where does economic gravity come from?

- ▶ ...and what is wrong with it?
- ▶ Let's sketch one possible derivation.

Where does economic gravity come from?

- ▶ Takeaway

- ▶ Theoretically grounded gravity slightly different:
- ▶ Gravity equation (theoretically grounded):

$$X_{ij} = R_j \frac{\text{GDP}_i \text{GDP}_j}{d_{ij}^\theta}$$

- ▶ Remoteness term is important

- ▶ Portugal-Austria about the same distance as Australia-New Zealand
- ▶ GDP products also about the same
- ▶ But New Zealand-Australia trade nine times higher!

- ▶ Gravity equation (theoretically grounded):

$$X_{ij} = R_j \frac{\text{GDP}_i \text{GDP}_j}{d_{ij}^\theta}$$

- ▶ We learned that if $\theta = 1$, exports halve if distance doubles.
- ▶ What would happen to Portugal-Austrian trade if we moved Portugal twice as far away into the Atlantic Ocean?

- ▶ Some recent gravity research:
- ▶ Head, Meier, and Reis, The Erosion of Colonial Trade Linkages, Journal of International Economics, 2010

3. Specification

In order to estimate the effects of independence, we need a benchmark for the amount of trade expected had independence not occurred. We will follow the common practice of modeling “expected” bilateral trade using a specification based on the gravity equation.

All the well-known empirical and theoretical formulations of the gravity equation can be represented in the following equation for the value of x_{ijt} , the exports from exporting country i to importing country j in year t :

$$x_{ijt} = G_t M_{it}^{\text{ex}} M_{jt}^{\text{im}} \phi_{ijt}. \quad (1)$$

Figure 2: Trade of Ivory Coast and Ghana with their respective metropolises

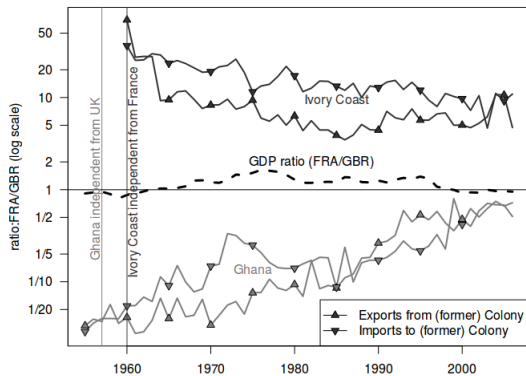
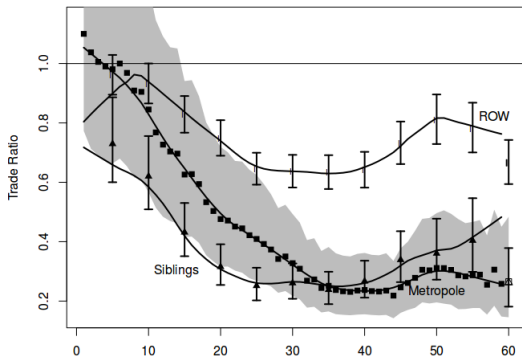


Figure 7: Trade with metropole, “siblings,” and rest-of-world after independence



- ▶ End gravity section
- ▶ Begin Ricardo review

The Ricardian model

- ▶ Reason for trade 'technology' differences other models: resource endowments, increasing returns to scale
- ▶ Countries *can* make more by specializing (to some degree)
- ▶ Countries *will* specialize if allowed to trade freely
- ▶ Free trade weakly benefits all participants (relative to autarchy) *even if some countries are terrible at everything.*

The RA Parable



source: <http://en.wikipedia.org/wiki/Latte>

The RA Parable

- ▶ What have we learned:
 1. We can produce more by specializing
 2. Even terrible partner can help, by doing what he is less terrible at.
- ▶ It is *possible* to increase production through specialization
- ▶ Will this happen in the free market?
- ▶ If so, which country gains from free trade?

The Ricardian Model

- ▶ Simplest model able to examine these issues.
- ▶ Environment:
 - ▶ Two countries
 1. Home has L hours of labor
 2. Foreign has L^* hours of labor
 - ▶ Two goods - wine and cheese

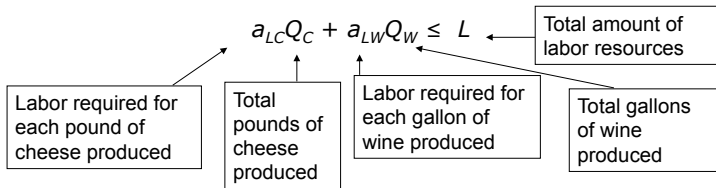
Production

- ▶ Only input to wine and cheese production is labor
- ▶ Competitive markets, free entry of firms, no profits
- ▶ Home
 - ▶ One unit of wine takes a_w hours
 - ▶ One unit of cheese takes a_c hours
- ▶ Foreign
 - ▶ One unit of wine takes a_w^* hours
 - ▶ One unit of cheese takes a_c^* hours
- ▶ Jargon: differences in production technology



Production Possibilities

- The **production possibility frontier** (PPF) of an economy shows the *maximum* amount of a goods that can be produced for a fixed amount of resources.
- The production possibility frontier of the home economy is:



Comparative Advantage

- ▶ Assume $\frac{a_c}{a_w} < \frac{a_c^*}{a_w^*}$
- ▶ AKA Home has a comparative advantage in cheese
- ▶ Don't know if a_c is less or greater than a_c^*
- ▶ Absolute advantage not important for analysis

Actions

- ▶ Supply
 - ▶ Workers freely mobile between wine and cheese
 - ▶ Work in sector with higher wages
 - ▶ Cannot move between countries
- ▶ Demand
 - ▶ Consumers consume wine and cheese to maximize utility
 - ▶ Constrained by labor income
 - ▶ If price of one good rises, substitute other good
 - ▶ Free Trade: Can buy goods produced anywhere

Equilibrium conditions

- ▶ Prices, wages, good and labor quantities such that:
 1. Good quantities solve representative consumer's maximization problem given prices and wages
 2. Labor quantities satisfy firm's problem given prices and wages
 3. International goods markets clear
 4. Domestic labor markets clear
 5. Trade is balanced
- ▶ We will summarize all these conditions with a (relative) supply and demand chart.

Detour: Some immediate implications

- ▶ Autarchy wage is the value of a worker's product. Why?

$$w = \frac{P_c}{a_c} = \frac{P_w}{a_w}$$

- ▶ Krugman et al. writes it this way:

$$\frac{P_c}{P_w} = \frac{a_c}{a_w}$$

- ▶ What happens if P_c goes up a tiny bit?

Graphical analysis of equilibrium

- ▶ Krugman et. al being a bit tricky with demand. . .

Section 2: Analysis of model results

- ▶ What was the point of all this work?
- ▶ Question 1: Does trade cause specialization?
- ▶ Question 2: Does trade make people better off? In which country?

$$\frac{a_c}{a_w} \leq \frac{P_c^e}{P_w^e} \leq \frac{a_c^*}{a_w^*}$$

Gains from trade

- ▶ How much wine can home get with one hour of labor?
- ▶ Autarchy: $\frac{1}{a_w}$
- ▶ Trade: $\frac{P_c^e}{P_w^e} \frac{1}{a_c}$
- ▶ Ricardian equilibrium:

$$\frac{P_c^e}{P_w^e} \frac{1}{a_c} \geq \frac{P_c^a}{P_w^a} \frac{1}{a_c} = \frac{a_c}{a_w} \frac{1}{a_c} = \frac{1}{a_w}$$

Gains from trade

- ▶ Textbook: Expansion in consumption possibilities frontier
- ▶ What is the slope of the consumption possibilities frontier under free trade?

Relative wages

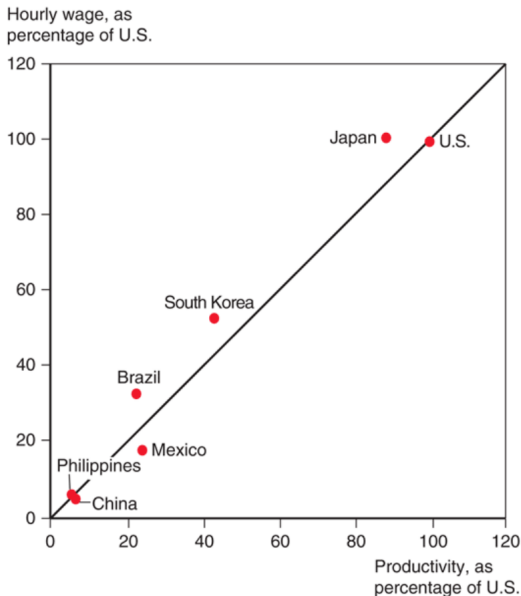
- ▶ All countries weakly gain from trade
- ▶ Does not mean that wages are the same across countries

- ▶ $w = \frac{p_c^e}{a_c}$

- ▶ $w^* = \frac{p_w^e}{a_w^*}$

- ▶ $\frac{a_w^*}{a_w} \leq \frac{w}{w^*} \leq \frac{a_c^*}{a_c}$

Typical: low productivity, low wage



Source: International Monetary Fund, Bureau of Labor Statistics, and The Conference Board.

Some additional observations

- ▶ The more different comparative advantage, the more likely mutual gains
- ▶ Countries with bad technology are more likely to gain from trade (developing countries!)

Ricardo with many goods

- ▶ Analysis similar
- ▶ “Derived demand”: relative demand for labor rather than goods
- ▶ False prediction: at most one good produced in both countries

Ricardo with many goods

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Ricardo with freely mobile labor

- ▶ First two-good model
 1. If one country has absolute advantage in both goods, where will people live?
 2. If each country has absolute advantage in one good, where will people live?
 3. Is it comparative or absolute advantage that determines trade patterns?
 4. What equilibrium condition are we adding to the model?
- ▶ Many good model:
 1. Can we compare absolute advantage as we did in the two-country case?
 2. How can we use the derived demand chart to find the equilibrium here?

Trade costs and non-tradables

- ▶ High trade costs, countries both produce weak comparative advantage goods
- ▶ Non-tradables are goods with very high trade costs
- ▶ Still specialize in goods with largest comparative advantage

Recent extensions to the Ricardian model

- ▶ Extension to many goods-easy
- ▶ Extension to many countries-difficult
- ▶ Eaton and Kortum (2002) linked a Ricardian model to a gravity equation
- ▶ Methodology has united and revolutionized economic research in trade

Section 3: Odds and ends

- ▶ Confronting the data
- ▶ Common misconceptions
- ▶ Limitations of Ricardo

Empirical results on Ricardo

- ▶ Ricardian model is simple, world is complex
 1. More than two countries
 2. More than two goods
 3. In particular, more than one input in production
- ▶ Takeaway: the empirical 'tests' of Ricardo are somewhat ad-hoc and atheoretical
- ▶ Basic prediction – comparative advantage should correspond to trade flows
- ▶ Countries should export goods for which their relative productivity is high

Side note: Productivity

- ▶ Plastic, electricity, electrical components come to the gate of the iPhone factory
- ▶ Productivity growth – we can use exactly the same input materials and produce more iPhones
- ▶ Productivity growth is what makes us rich
- ▶ For our purposes, (labor) productivity is:

$$\frac{\text{factory output value} - \text{factory input material value}}{\text{number of employees}}$$

China and Bangladesh

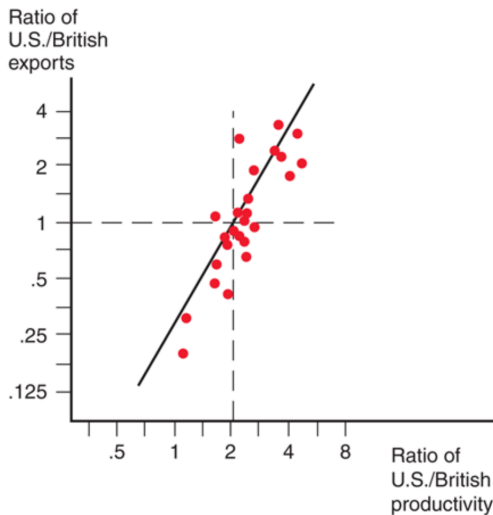
- Prediction: Bangladesh *relatively* productive in textiles

	Bangladeshi Output per Worker as % of China	Bangladeshi exports as % of China
All industries	28.5	1.0
Apparel	77	15.5

Source: McKinsey and Company, “Bangladesh’s ready-made garments industry: The challenge of growth,” 2012; UN Monthly Bulletin of Statistics.

US and UK

- Prediction: US will export relatively more in industries in which it is relatively productive



Popular misconceptions

1. Trade only helps countries that are more productive than other countries
 - ▶ Trade helps poor countries avoid wasting resources in unproductive industries
2. Trade with low wage countries hurts high wage countries (*pauper labor* argument)
 - ▶ Trade allows consumers in rich countries to buy goods more cheaply
 - ▶ Trade may, however, hurt some in rich countries – next class
3. Trade hurts poor countries because low wages are needed to allow exports
 - ▶ Too bad that people have low wages, but what is the alternative?
 - ▶ Detour: Same reply to sweatshop protesters

Limitation of Ricardo

- ▶ Original Ricardo example(1819): Portugal and the UK, clothes and wine.
- ▶ Portugal better at both, still gains from trading with UK.
- ▶ Joan Robinson's cheap shot:
- ▶ Portugal *did* open up to trade with the UK at this time – experienced a century of decline!

Limitation of Ricardo

- ▶ Begs the question: why do countries have different technology?
- ▶ Can't move the weather – Denmark grows corn and Jordan dates.
- ▶ Why can't we just manufacture everything everywhere and avoid trade costs?

Institutions

- ▶ Due to the legacy of history or maybe culture, different:
 - ▶ ease of contract enforcement
 - ▶ ease of accessing credit
 - ▶ level of trust
 - ▶ ease of hiring and firing employees
 - ▶ crime
 - ▶ government regulations and bureaucracy
- ▶ One way to explain link between location and productivity

Summary

- ▶ Ricardian model
 - ▶ Reason for trade: technology
 - ▶ Mechanism: Reducing production using poor technologies
- ▶ Some results
 - ▶ Comparative, not absolute, advantage determines trade flows
 - ▶ Careful equilibrium analysis – every country (weakly) gains from free trade
 - ▶ Gains more likely for smaller, poorer countries with very large comparative advantage
 - ▶ Wages can be very different across countries in equilibrium
- ▶ Confronting the data
 - ▶ Evidence that Ricardo is part, but not all, of the story
 - ▶ People within a country are not homogenous

- ▶ Next time:
 - ▶ Who gains and who loses if trade is allowed?
 - ▶ The specific-factor model
 - ▶ Explains why pro-trade policies are often unpopular politically



A Numerical Example

Unit labor requirements for home and foreign countries

	Cheese	Wine
Home	$a_{LC} = 1$ hour/lb	$a_{LW} = 2$ hours/gallon
Foreign	$a_{LC}^* = 6$ hours/lb	$a_{LW}^* = 3$ hours/gallon

- What is the home country's opportunity cost of producing cheese? $a_{LC} / a_{LW} = 1/2$, to produce one pound of cheese, stop producing $1/2$ gallon of wine.



A Numerical Example (cont.)

- The home country is more efficient in both industries, but has a comparative advantage only in cheese production.

$$1/2 = a_{LC} / a_{LW} < a^*_{LC} / a^*_{LW} = 2$$

- The foreign country is less efficient in both industries, but has a comparative advantage in wine production.



A Numerical Example (cont.)

- With trade, the equilibrium relative price of cheese to wine settles between the two opportunity costs of cheese.
- Suppose that the intersection of RS and RD occurs at $P_C/P_W = 1$ so one pound of cheese trades for one gallon of wine.
- Trade causes the relative price of cheese to rise in the home country and fall in foreign.



A Numerical Example (cont.)

- With trade, the foreign country can buy one pound of cheese for $P_C / P_W =$ one gallon of wine,
 - instead of stopping production of $a_{LC}^* / a_{LW}^* = 2$ gallons of wine to free up enough labor to produce one pound of cheese in the absence of trade.
 - Suppose $L^* = 3,000$. The foreign country can trade its 1,000 gallons maximum production of wine for 1,000 pounds of cheese, instead of the 500 pounds of cheese it could produce itself.



A Numerical Example (cont.)

- With trade, the home country can buy one gallon of wine for $P_W / P_C =$ one pound of cheese,
 - instead of stopping production of $a_{LW} / a_{LC} =$ two pounds of cheese to free up enough labor to produce one gallon of wine in the absence of trade.
- The home country can trade its 1,000 pounds maximum production of cheese for 1,000 gallons of wine, instead of the 500 gallons of wine it could produce itself.



Relative Wages

- **Relative wages** are the wages of the home country relative to the wages in the foreign country.
- Productivity (technological) differences determine relative wage differences across countries.
- The home wage relative to the foreign wage will settle in between the ratio of how much better Home is at making cheese and how much better it is at making wine compared to Foreign.
- Relative wages cause Home to have a cost advantage in only cheese and Foreign to have a cost advantage in only wine.



Relative Wages (cont.)

- Suppose that $P_C = \$12/\text{pound}$ and $P_W = \$12/\text{gallon}$.
- Since domestic workers specialize in cheese production after trade, their hourly wages will be

$$P_C/a_{LC} = \$12 / 1 = \$12$$

- Since foreign workers specialize in wine production after trade, their hourly wages will be

$$P_W/a_{LW}^* = \$12/3 = \$4$$

- The relative wage of domestic workers is therefore
 $\$12/\$4 = 3$



Relative Wages (cont.)

- The relative wage lies between the ratio of the productivities in each industry.
 - The home country is $6/1 = 6$ times as productive in cheese production, but only $3/2 = 1.5$ times as productive in wine production.
 - The home country has a wage 3 times higher than the foreign country.



Relative Wages (cont.)

- These relationships imply that both countries have a *cost advantage* in production.
 - High wages can be offset by high productivity.
 - Low productivity can be offset by low wages.
- In the home economy, producing one pound of cheese costs \$12 (one worker paid \$12/hr) but would have cost \$24 (six paid \$4/hr) in Foreign.
- In the foreign economy, producing one gallon of wine costs \$12 (three workers paid \$4/hr) but would have cost \$24 (two paid \$12/hr) in Home.



Relative Wages (cont.)

- Because foreign workers have a wage that is only $\frac{1}{3}$ the wage of domestic workers, they are able to attain a cost advantage in wine production, despite low productivity.
- Because domestic workers have a productivity that is 6 times that of foreign workers in cheese production, they are able to attain a cost advantage in cheese production, despite high wages.