International Economics I

The Ricardian Model

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Introduction

- In the neoclassical frameworks, there is trade when there is **comparative advantage**.
- Differences in factor endowments (capital, labor, land,...): $\Rightarrow$ Heckscher-Ohlin model.
- Technological differences across countries $\Rightarrow$ The Ricardian model.
  - e.g., Germany exports cars because it is much better at producing cars than most of the countries.
- In the Ricardian model, a country's comparative advantage depends on:
  - the relative productivity of labor across industries
  - the relative wage across countries

Introduction

- We will study how differences in productivity generate a specific pattern of trade.
- The framework will have multiple goods.
- Study in details where the gains from trade come from.

Useful to:

- Understand how increase in the productivity of a country change its trade pattern.
- Understand happens if more countries (e.g., China and India) open to trade.
- How trade costs change which goods we export and import.

Introduction

- We will study the Ricardian model developed in Dornbusch, Fischer and Samuelson (1977).
- The model is the backbone of more advanced Ricardian trade models such as Eaton and Kortum (2002).
- The Eaton and Kortum (2002) is one of the most used quantitative models to study trade with multiple country and multiple goods.

Outline

Setup

- 2 countries: home and foreign (*)
- Many goods: indexed by $i = 1, ..., N$, N large ($\to \infty$)
- 1 factor of production: labor (L and L^*):
  - Mobile between sectors
  - Immobile between countries
- Technologies with constant returns to scale:
  - Different across sectors
  - Different across countries (source of comparative advantage)
- Same preferences in both countries.
- Perfect competition.

Technology

- N goods (sectors) indexed by $i = 1, 2, ..., N$.
- In Home, we need a_{Li} units of L to produce one unit of good i:

$$Q_i = \frac{L_i}{a_{Li}}: \quad Q_1 = \frac{L_1}{a_{L1}}, \; Q_2 = \frac{L_2}{a_{L2}}, ..., \; Q_N = \frac{L_N}{a_{LN}}$$

  - Q_i = units of i produced.
  - L_i = units of labor employed in sector i.
  - $1/a_{Li}$ = home labor productivity in sector i.
- In foreign, we need a^*_{Li} units of L^* to produce one unit of good i.

$$Q^*_i = \frac{L^*_i}{a^*_{Li}}$$

  - $1/a^*_{Li}$ = foreign labor productivity in sector i

Technology

- The resource constraint with many goods implies:

$$L = L_1 + L_2 + ... + L_N = a_{L1}Q_1 + a_{L2}Q_2 + ... + a_{LN}Q_N \tag{1}$$

- Note that because of the linear production function the PPF is a straight line.
- **Example:** 2 goods, $L = a_{L1}Q_1 + a_{L2}Q_2$:

$$Q_1 = \frac{L}{a_{L1}} - \frac{a_{L2}}{a_{L1}}Q_2 \tag{2}$$

- The PPF has slope $\frac{a_{L2}}{a_{L1}}$.

Technology and Relative Productivity

- Suppose that Home and Foreign have different technologies: $a_{Li} \neq a^*_{Li}$ for all goods $i = 1, 2, ..., N$.
- home more productive in sector j if

$$a_{Lj} < a^*_{Lj}, \text{ i.e., } \frac{a^*_{Lj}}{a_{Lj}} > 1$$

- We can compare two goods, i.e. home is relatively more productive in good 1 if:

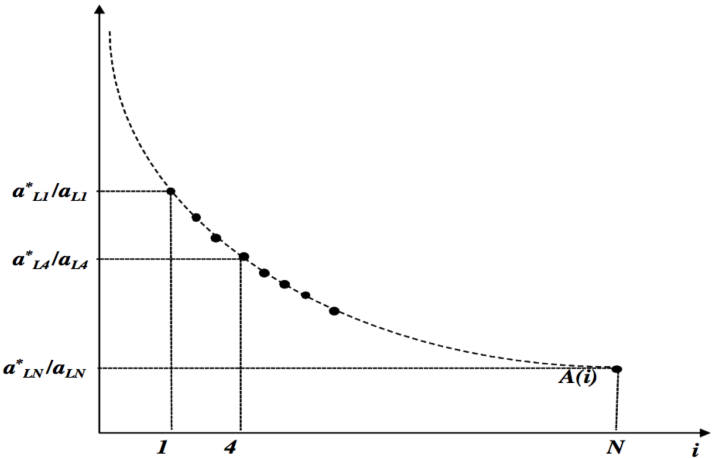
$$\frac{a^*_{L1}}{a_{L1}} > \frac{a^*_{L2}}{a_{L2}}$$

- For convenience, order goods by decreasing home relative productivity

$$\frac{a^*_{L1}}{a_{L1}} > \frac{a^*_{L2}}{a_{L2}} > ... > \frac{a^*_{LN}}{a_{LN}}$$

Relative Productivity: Graph

Draw in a graph the relative productivity line $A(i) \equiv a^*_{Li}/a_{Li}$.



Comparative Advantage and Efficient Specialization

- The problem of the firm for each i:

$$\max_{L_i} \pi_i = P_i Q_i - wL_i = p_i \frac{L_i}{a_i} - wL_i. \tag{3}$$

- In perfect competition, optimality condition implies p_i times MPL_i has to equal marginal cost

$$\begin{aligned} P_i &= a_{Li} \times w \\ P_i^* &= a_{Li}^* \times w^* \end{aligned}$$

- with w = wage at home and w^* = wage at foreign.
- Note that L is mobile across sectors, same wage in all sectors.

Comparative Advantage and Efficient Specialization

- Who ends up producing good i? The country that sells it cheaper!
- With free trade, the country that producer the good at a cheaper price "captures" the market. Hence the international price of good i is

$$P_i^I = \min\{P_i, P_i^*\} \tag{4}$$

- Home specializes in goods i with $P_i < P_i^*$
- these are the sectors where home relative productivity is higher than relative wage

$$P_i < P_i^* \iff \frac{a_{Li}^*}{a_{Li}} > \frac{w}{w^*}$$

Comparative Advantage and Efficient Specialization

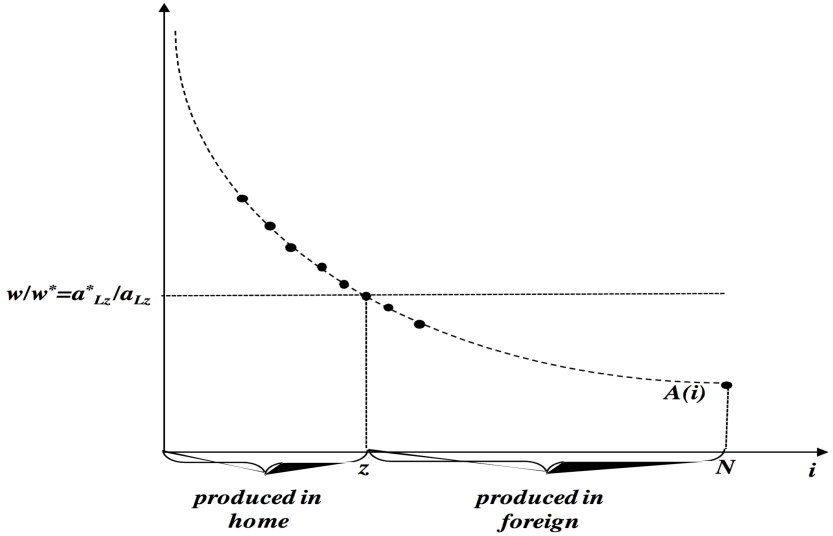
- For given relative wage w/w^*, there will be a marginal commodity z that

$$\frac{a^*_{Lz}}{a_{Lz}} = \frac{w}{w^*}$$

- Home produces all goods $i = 1, 2, ...z$
- The foreign country produces all goods $i = z+1, z+2, ...N$

$$\frac{a^*_{L1}}{a_{L1}} > ... > \frac{a^*_{Lz-1}}{a_{Lz-1}} > \frac{a^*_{Lz}}{a_{Lz}} = \frac{w}{w^*} > \frac{a^*_{Lz+1}}{a_{Lz+1}} > .... > \frac{a^*_{LN}}{a_{LN}}$$

Comparative Advantage and Efficient Specialization



Comparative Advantage and Efficient Specialization

- Note we can rewrite the problem in terms of relative prices, so we see the comparative advantage:
- The autarky price of $z-1$ relative to $z+1$ is:
  - in the home country
$$P_{z-1}/P_{z+1} = a_{Lz-1}/a_{Lz+1}$$
  - in the foreign country
$$p^* = P^*_{z-1}/P^*_{z+1} = a^*_{Lz-1}/a^*_{Lz+1}$$
- Since $\frac{a^*_{Lz-1}}{a_{Lz-1}} > \frac{a^*_{Lz+1}}{a_{Lz+1}}$, we have $\frac{P^*_{z-1}}{P^*_{z+1}} > \frac{P_{z-1}}{P_{z+1}}$!
- Home has a comparative advantage in $z-1$ and foreign has a comparative advantage in $z+1$.

Comparative Advantage and Efficient Specialization

- efficient specialization:
  - a country produces the goods of its comparative advantage
- comparative advantage:
  - the country's relative productivity is high enough so to compensate its relative cost of labor
- comparative vs absolute advantage:
  - a country doesn't need to have higher labor productivity (absolute advantage) to specialize in a good
    - ⋆ even if $a_{Li} > a^*_{Li}$, can have $P_i < P^*_i$ provided that the relative wage is low enough $(w/w^* < a^*_{Li}/a_{Li} < 1)$
  - absolute advantage may not be sufficient.

Relative Wage and Efficient Specialization

If the relative wage increases:

- home specializes in the production of fewer goods ($w/w^* \uparrow \rightarrow z \downarrow$)
- home produces only in the sectors where its relative productivity is higher
- home becomes on average more productive relative to the foreign country

Equilibrium in Open Economy

- How is the relative wage determined?
  - Supply = Demand of home produced goods
  - Supply = Demand of foreign produced goods
- The $A(i)$ schedule represents the supply for given relative wage w/w^*.
  - depends on technology (the "a's").
- Demand depends on preferences and relative mass of consumers.

Demand Side: Preferences

- Preferences are the same in both countries.
- Assume that consumers want to spend in each good the same share $(1/N)$ of their income (wL).
  - home expenditure in good j : $wL \times 1/N$
  - foreign expenditure in good j : $w^*L^* \times 1/N$
  - total expenditure in good j: $(wL + w^*L^*)/N$
- for given marginal good z
  - home expenditure in home-produced goods $= wL \times z/N$
  - foreign expenditure in home-produced goods $= w^*L^* \times z/N$

Demand Side: Market Clearing

- equilibrium in the "home" goods market, for given specialization z
  - home exports = home imports (trade is balanced)

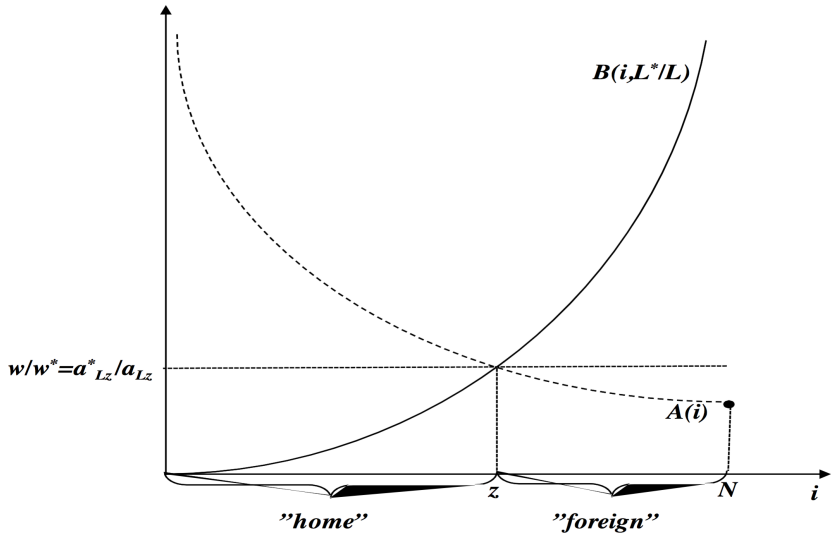
$$w^* L^* \times z/N = wL \times (N - z)/N$$

  - Express this in terms of marginal commodity z and w/w^*

$$\frac{w}{w^*} = \frac{L^*}{L}\frac{z}{N-z} \equiv B\left(z, \frac{L^*}{L}\right)$$

  - for given specialization pattern (z), the relative wage must clear the market
  - if home specializes in more goods ($z \uparrow$)
    - ★ relative demand of home goods (and labor) increases ($z/(N-z)) \uparrow$
    - ★ home income must increase ($w/w^*) \uparrow$ to restore the equilibrium
- to draw the demand-side, $B\left(i, \frac{L^*}{L}\right)$, assume any i to be the marginal good
  - $B\left(i, \frac{L^*}{L}\right)$ is increasing in i

Equilibrium in Open Economy: Graph



Equilibrium in Open Economy: Properties

- Home produces z goods and has a relative wage of w/w^*.
- Equilibrium values depend on:
  - Technological differences between home and foreign (the slope of $A(i)$).
  - The size of both countries (L^*/L).

$$A(z) = \frac{w}{w^*} = \frac{L^*}{L}\frac{z}{N-z} \equiv B\left(z, \frac{L^*}{L}\right) \tag{5}$$

- we'll see how the equilibrium varies with these variables

Outline

Equilibrium in Open Economy: Properties

- Home produces z goods and has a relative wage of w/w^*.
- Equilibrium values depend on:
  - Technological differences between home and foreign (the slope of $A(i)$).
  - The size of both countries (L^*/L).

$$A(z) = \frac{w}{w^*} = \frac{L^*}{L}\frac{z}{N-z} \equiv B\left(z, \frac{L^*}{L}\right) \tag{6}$$

- we'll see how the equilibrium and how gains from trade varies with these variables

Equilibrium in Open Economy: Real Wage

- the purchasing power of home wage in terms of good i is
  - in closed economy (recall $P_i = w \times a_{Li}$),

$$\frac{w}{P_i} = \frac{1}{a_{Li}} \quad \text{for } i = 1, 2, ..., N$$

    since home produces all goods
  - in open economy,

$$\frac{w}{P_i^I} = \begin{cases} \frac{w}{P_i} = \frac{1}{a_{Li}} & \text{for } i = 1, 2, ..., z \\ \frac{w}{P_i^*} = \frac{w}{w^* a_{Li}^*} & \text{for } i = z+1, ..., N \end{cases}$$

    since home produces all goods up to z and the foreign country the remaining $N - z$.

Gains From Trade: Home

- To compare the real wage in autarky and in open economy
- home real wage
  - is unchanged in terms of the goods that remain "home" ($i \leq z$)

$$w/P_i^I = w/P_i = 1/a_{Li} \quad \text{for } i = 1, 2, ..., z$$

  - increases in terms of the goods of foreign specialization ($z < i \leq N$)

$$\frac{w/P_i^I}{w/P_i} = \frac{w/P_i^*}{w/P_i} = \frac{a_{Li}w}{a_{Li}^* w^*} > 1 \quad \text{for } i = z+1, ..., N$$

    as the foreign country has comparative advantage in these sectors ($a_{Li}^*/a_{Li} < w/w^*$)
- gains from trade:
  - home can consume
    - ⋆ the same units of goods $i = 1, 2, ...z$
    - ⋆ more units of goods $i = z+1, ..., N$
    - ⋆ since they are produced cheaper in the foreign country

Gains From Trade: Foreign

- compare the real wage in autarky and in open economy
- foreign real wage
  - increases in terms of "home" goods ($i \leq z$)

$$\frac{w^*/P_i^I}{w^*/P_i^*} = \frac{w^*/P_i}{w^*/P_i^*} = \frac{a_{Li}^* w^*}{a_{Li} w} > 1 \quad \text{for } i = 1, 2, ..., z$$

    as home has comparative advantage in these sectors ($a_{Li}^*/a_{Li} > w/w^*$)
  - is unchanged in terms of goods that remain "foreign" ($z < i \leq N$)

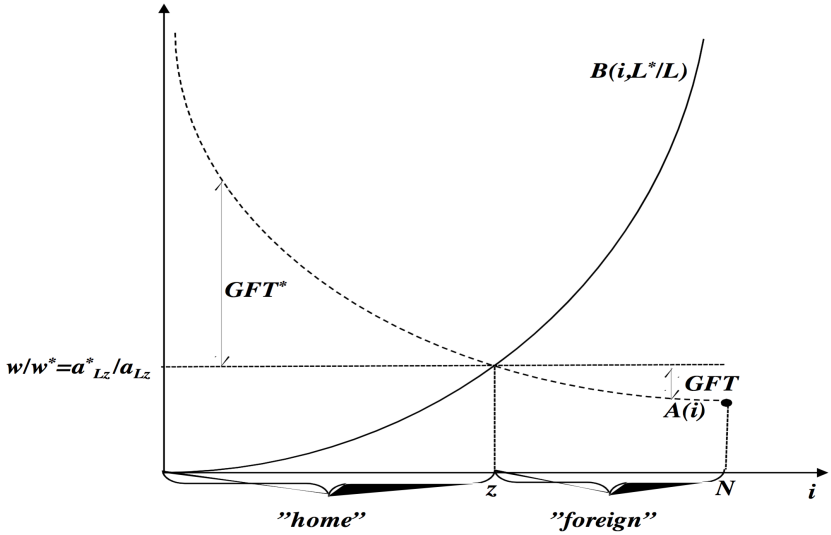
$$w^*/P_i^I = w^*/P_i^* = 1/a_{Li}^* \quad \text{for } i = z+1, ..., N$$

- gains from trade:
  - the foreign country can consume
    - more units of goods $i = 1, 2, ...z$
    - since they are produced cheaper in "home"
    - the same units of goods $i = z+1, ..., N$

Gains From Trade

- the GFT for both countries depend on the difference between relative productivity and the relative wage (a^*_{Li}/a_{Li} & w/w^*):
  - the higher the difference the larger the GFT
  - in the graph, the gains are proportional to the areas between the $A(i)$ schedule and the equilibrium relative wage
  - the more diverse the trading partners (steeper $A(i)$), the larger their GFT

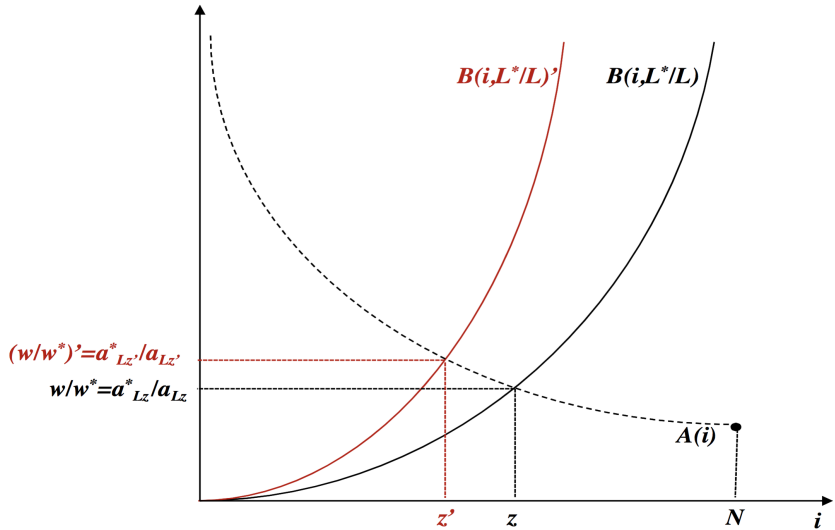
Gains From Trade: Graph



Country Size and Pattern of Trade

- suppose the foreign country becomes larger ($L^*/L \uparrow$):
  - for given specialization (z), the demand for home goods increases
  - relative wage increases: $(w/w^*)' > (w/w^*)$
  - $w/w^* \uparrow \rightarrow$ home loses comparative advantage in the goods with lower relative productivity ($a^*_{Lz'}/a_{Lz'} > a^*_{Lz}/a_{Lz}$)
    - home specializes in less goods: $z' < z$
    - home average relative productivity increases
  - $w/w^* \uparrow \rightarrow$ foreign acquires comparative advantage in the sectors of lower relative productivity ($a^*_{Lz'}/a_{Lz'} > a^*_{Lz}/a_{Lz}$)
    - foreign specializes in more goods
    - foreign average relative productivity falls

Size and Pattern of Trade



Size and Gains From Trade

- Consider home real wage as a welfare indicator (before and after the change of L^*).
- Divide in three sections of goods:

$$\frac{w}{P_i^I} = \begin{cases} \frac{1}{a_{Li}} & \text{for } i = 1, 2, ...z' \\ \frac{1}{a_{Li}} & \text{for } i = z' + 1, ...z \\ \frac{1}{a_{Li}^*} \frac{w}{w^*} & \text{for } i = z + 1, ...N \end{cases}$$

$$\left(\frac{w}{P_i^I}\right)' = \begin{cases} \frac{1}{a_{Li}} & \text{for } i = 1, 2, ...z' \\ \frac{1}{a_{Li}^*} \left(\frac{w}{w^*}\right)' & \text{for } i = z' + 1, ...z \\ \frac{1}{a_{Li}^*} \left(\frac{w}{w^*}\right)' & \text{for } i = z + 1, ...N \end{cases}$$

- Note $(w/w^*)'$ is the relative wage after the change.

Size and Gains From Trade

- home welfare:
  - is unchanged in terms of the goods that remain "home" $(i \leq z')$
  - increases in terms of the goods that shift to "foreign" $(z' < i \leq z)$
    - ⋆ since they become cheaper due to efficient specialization:
    - ⋆ recall these goods are produced by "foreign":

$$\left(\frac{w}{w^*}\right)' > \frac{a^*_{Li}}{a_{Li}} \rightarrow \frac{1}{a^*_{Li}}\left(\frac{w}{w^*}\right)' > \frac{1}{a_{Li}}$$

  - increases in terms of the goods that remain "foreign"
    - ⋆ since they become cheaper due to $\left(w/w^*\right)' / a^*_{Li} > \left(w/w^*\right) / a^*_{Li}$

Size and Gains From Trade

- consider foreign real wage as a welfare indicator:

$$\frac{w^*}{P_i^I} = \begin{cases} \frac{1}{a_{Li}}\frac{w^*}{w} & \text{for } i = 1, 2, ...z' \\ \frac{1}{a_{Li}}\frac{w^*}{w} & \text{for } i = z'+1, ...z \\ \frac{1}{a_{Li}^*} & \text{for } i = z+1, ...N \end{cases}$$

$$\left(\frac{w}{P_i^I}\right)' = \begin{cases} \frac{1}{a_{Li}}\left(\frac{w^*}{w}\right)' & \text{for } i = 1, 2, ...z' \\ \frac{1}{a_{Li}^*} & \text{for } i = z'+1, ...z \\ \frac{1}{a_{Li}^*} & \text{for } i = z+1, ...N \end{cases}$$

Size and Gains From Trade

- foreign welfare:
  - falls in terms of the goods that remain "home" ($i \leq z'$)
    - ⋆ since home goods become more expensive due to higher relative wage
  - falls in terms of the goods that shift to "foreign" ($z' < i \leq z$)
    - ⋆ since they become more expensive due to low foreign productivity

$$\left(\frac{w}{w^*}\right)' > \frac{a^*_{Li}}{a_{Li}} > \frac{w}{w^*} \rightarrow \frac{1}{a_{Li}}\frac{w^*}{w} > \frac{1}{a^*_{Li}}$$

  - is unchanged in terms of the goods that remain "foreign"

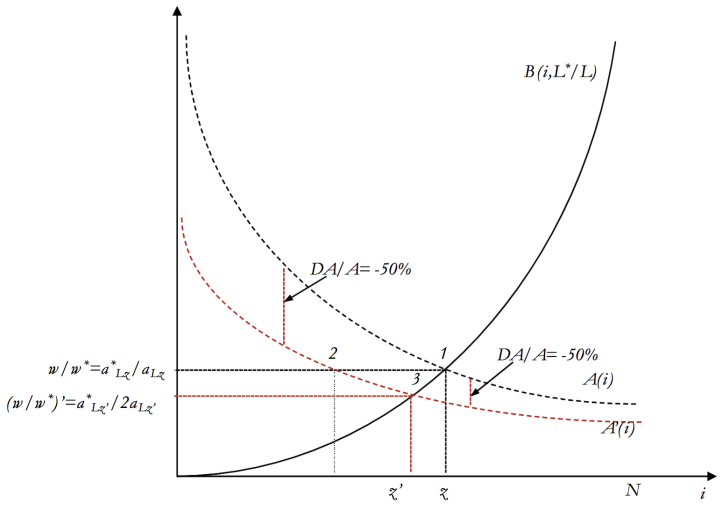
Size and Gains From Trade

- what did we learn from this exercise?
- small countries gain more from trade
  - can specialize in few sectors, where they have the highest relative productivity
  - can import more goods at a cheaper price
- advanced countries benefit from China and India opening to trade (the South becomes larger)
  - can specialize in sectors of higher technological advantage (e.g., PCs, ICT etc...)
  - import cheaper in sectors with less advanced technology (e.g., textiles)

(Uniform) Technological Progress and Trade

- foreign relative productivity increases in all sectors: $(a^*_{Li})' < a^*_{Li} \rightarrow A(i) \downarrow$ for all i
  - for given relative wage, home stops producing the goods in which it loses enough relative productivity $z \downarrow$ (1$\rightarrow$2)
  - for given w/w^* and specialization in less goods, relative demand falls
  - the relative wage has to fall reflecting the fall in home relative productivity $(w/w^*)' < w/w^*$ (2$\rightarrow$3)
  - the foreign country specializes in more sectors and enjoys higher relative wage due to technological improvement

Technological Progress and Pattern of Trade



Technological Progress and GFT

- consider home real wage as a welfare indicator:

$$\frac{w}{P_i^I} = \begin{cases} \frac{1}{a_{Li}} & \text{for } i = 1, 2, ...z' \\ \frac{1}{a_{Li}} & \text{for } i = z' + 1, ...z \\ \frac{1}{a_{Li}^*} \frac{w}{w^*} & \text{for } i = z + 1, ...N \end{cases}$$

$$\left(\frac{w}{P_i^I}\right)' = \begin{cases} \frac{1}{a_{Li}} & \text{for } i = 1, 2, ...z' \\ \frac{1}{\left(a_{Li}^*\right)'} \left(\frac{w}{w^*}\right)' & \text{for } i = z' + 1, ...z \\ \frac{1}{\left(a_{Li}^*\right)'} \left(\frac{w}{w^*}\right)' & \text{for } i = z + 1, ...N \end{cases}$$

Technological Progress and GFT

- home welfare:
  - is unchanged in terms of the goods that remain "home" $(i \leq z')$
  - increases in terms of the goods that switch to "foreign" $(z' < i \leq z)$
    - ★ become cheaper due to efficient specialization

$$\left(\frac{w}{w^*}\right)' > \frac{(a_{Li}^*)'}{a_{Li}} \rightarrow \frac{1}{(a_{Li}^*)'}\left(\frac{w}{w^*}\right)' > \frac{1}{a_{Li}}$$

  - increases in terms of the goods that remain "foreign"
    - ★ become more expensive due to lower relative wage: $(w/w^*)' < (w/w^*)$
    - ★ become cheaper due to higher foreign productivity: $(a_{Li}^*)' < a_{Li}^*$
    - ★ overall: foreign goods become relatively cheaper since $|\Delta (w/w^*)| < |\Delta a_{Li}^*|$
    - ★ the relative wage decrease less because higher demand for home goods raise wages at home as well

Technological Progress and GFT

- consider foreign real wage as a welfare indicator:

$$\frac{w^*}{P_i^I} = \begin{cases} \frac{1}{a_{Li}}\frac{w^*}{w} & \text{for } i = 1, 2, ...z' \\ \frac{1}{a_{Li}}\frac{w^*}{w} & \text{for } i = z'+1, ...z \\ \frac{1}{a_{Li}^*} & \text{for } i = z+1, ...N \end{cases}$$

$$\left(\frac{w}{P_i^I}\right)' = \begin{cases} \frac{1}{a_{Li}}\left(\frac{w^*}{w}\right)' & \text{for } i = 1, 2, ...z' \\ \frac{1}{\left(a_{Li}^*\right)'} & \text{for } i = z'+1, ...z \\ \frac{1}{\left(a_{Li}^*\right)'} & \text{for } i = z+1, ...N \end{cases}$$

Technological Progress and GFT

- foreign welfare:
  - increases in terms of the goods that remain "home" $(i \leq z')$
    - ⋆ become cheaper due to lower relative wage $(w/w^*)' < (w/w^*)$
  - increases in terms of the goods that switch to "foreign" $(z' < i \leq z)$
    - ⋆ become cheaper as foreign higher productivity outweighs higher relative wage

$$\frac{(a^*_{Li})'}{a_{Li}} < \frac{w}{w^*} \rightarrow \frac{1}{(a^*_{Li})'} > \frac{1}{a_{Li}} \frac{w^*}{w}$$

  - increases in terms of the goods that remain "foreign"
    - ⋆ become cheaper due to higher foreign productivity

Technological Progress and GFT

- what did we learn from this exercise?
- both trade partners gain if one experiences technological progress in all sectors
- the country that experences it gains more
- we should not be afraid of technological progress in poor countries, as long as it is uniform (in all sectors)...

Technological Catch-Up and GFT

- suppose, as in Samuelson (2004), that:
  - home (North) starts with an absolute advantage in all sectors: $a^*_{Li} > a_{Li}$ for all i
  - foreign (South) catches up in technology in all sectors: $(a^*_{Li})' = a_{Li}$
  - the $A(i)$ becomes flat
- this maximizes world production
  - as if the North (e.g., the US) produced everything for all the world
- South gains
  - reaches the level of per capita GDP of the North
- North loses all the GFT, as it goes back to its closed-economy equilibrium
  - the US stop enjoying cheap textiles import from China

Outline

Transport Costs and Non-Tradeable Goods

- suppose there is a transport cost:
  - to get one unit of foreign good, home consumers have to buy $t > 1$ units ($t =$ iceberg cost)
  - the price of i for home consumers is

$$\begin{array}{ll} P_i = wa_{Li} & \text{if } i \text{ produced in home} \\ tP_i^* = tw^* a_{Li}^* & \text{if } i \text{ produced in foreign} \end{array}$$

  - the price of i for foreign consumers is

$$\begin{array}{ll} tP_i = twa_{Li} & \text{if } i \text{ produced in home} \\ P_i^* = w^* a_{Li}^* & \text{if } i \text{ produced in foreign} \end{array}$$

Transport Costs and Non-Tradeable Goods

- Home buys goods from foreign if it produces by a cheaper price:

$$P_i > tP_i^* \Rightarrow a_{Li}w > ta_{Li}^*w^* \Rightarrow \frac{w}{w^*} > \frac{a_{Li}^*}{a_{Li}}t$$

- Foreign buys goods from home if it produces by a cheaper price:

$$tP_i < P_i^* \Rightarrow ta_{Li}w < a_{Li}^*w^* \Rightarrow \frac{w}{w^*} < \frac{a_{Li}^*}{a_{Li}}\frac{1}{t}$$

- Clearly the "marginal good" z cannot be the same in both countries!
- There will be a region with goods that are not traded in the international markets.

Transport Costs and Non-Tradeable Goods

- efficient specialization for given relative wage:
  - home produces goods $i \leq z$ with

$$twa_{Lz} = w^* a^*_{Lz} \Longleftrightarrow w/w^* = A(z)/t$$

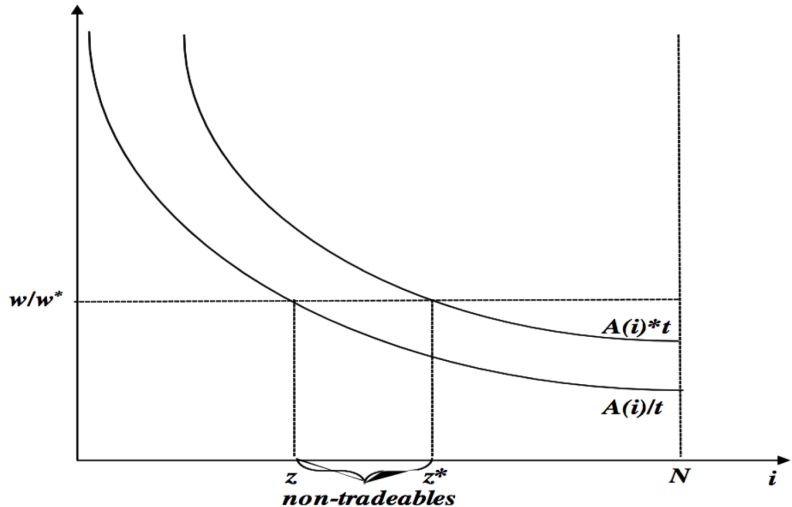
  - foreign produces goods $i \geq z^*$ with

$$wa_{Lz^*} = tw^* a^*_{Lz^*} \Longleftrightarrow w/w^* = A(z^*) * t$$

  - $A(z^*) * t > A(z)/t \rightarrow$ goods $z < i < z^*$ are non tradeable
- goods market equilibrium/balanced trade (home imports = home exports):

$$\frac{N - z^*}{N} wL = \frac{z}{N} w^* L^*$$

Transport Costs and Non-Tradeable Goods



Outline

Empirical Evidence and Applications

- limits of the model:
  - predicts perfect specialization: not observed
  - unable to address the redistributive effects of trade: only one factor
  - difficult to apply the baseline model to a world with many countries: which relative productivities?
- validity:
  - predicts that comparative, and not absolute, advantage determine the pattern of trade
  - evidence from 1963 on the US and the UK, 26 sectors :
    - ⋆ the US had absolute advantage in all sectors, but exported in only half of them
    - ⋆ the US exported more in the sectors where its relative productivity was higher

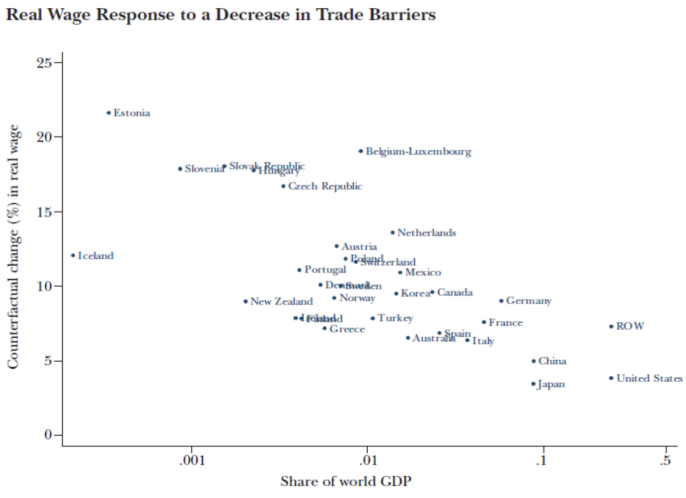
A Ricardian Model for Quantitative Analysis

- extension: Eaton and Kortum (2002)
  - many goods and countries + transport costs
  - for each good, instead of relative productivity, focus on the probability that a country is the most efficient producer
  - estimate model parameters so to reproduce the pattern of trade
- may use the model to evaluate quantitatively:
  - the gains from trade
  - the effects of a drop in transport costs and/or tariffs
  - the effects of technological progress
  - the effects of trade opening in a country (e.g., China)
  - the effects of global imbalances (and rebalancing)
  - more...

Quantifying the Gains from Trade

- in the model without trade costs + same preferences:
  - each country consumes a fraction of its production equal to its GDP as a share of world GDP
  - in reality, due to trade barriers, countries consume much more in domestic products
  - between 1996 and 2006 the expenditure share in domestic goods dropped significantly (globalization)
  - welfare effect:
    - ⋆ gains from trade increased
  - effect of a 25% drop in trade costs
    - ⋆ world trade/GDP doubles
    - ⋆ gains are positive and decreasing in country size

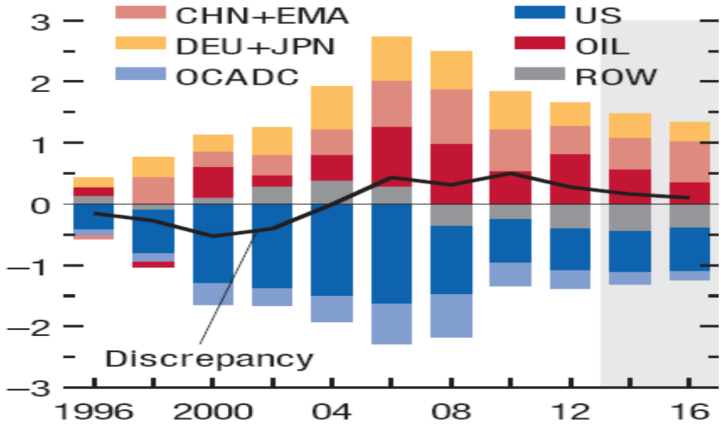
Quantifying the GFT



Application: Gobal Imbalances

- some countries transfer (lend) wealth to others (e.g., via trade surplus or capital flows) $\rightarrow$ global imbalances
- in recent years, China has been transferring billions of \$ to the US
- how does the imbalance affect the welfare of both?
- how would a rebalancing of the current account affect welfare?

Unbalanced Trade (% world GDP)



Current Account Surpluses (2011)

Country	CA in US$ bill.	CA as % GDP
Algeria	19.697	9.955
Argentina	-0.299	-0.067
Australia	-33.522	-2.254
Austria	8.147	1.947
Brazil	-52.48	-2.105
Canada	-48.906	-2.812
Chile	-3.222	-1.297
China	201.72	2.764
Colombia	-9.978	-3.046
Denmark	22.178	6.68
Egypt	-6.088	-2.583
Finland	-3.124	-1.186
France	-54.169	-1.95
Germany	203.929	5.653
Greece	-29.353	-9.808
Hong Kong	12.908	5.297
India	-62.756	-3.435
Ireland	2.484	1.123
Israel	1.907	0.783
Italy	-71.67	-3.26

Country	CA in US$ bill.	CA as % GDP
Japan	119.304	2.034
Korea	26.505	2.375
Kuwait	70.8	43.98
Mexico	-11.073	-0.96
Netherlands	70.901	8.46
Norway	70.289	14.48
Pakistan	0.214	0.102
Peru	-3.341	-1.885
Portugal	-15.339	-6.449
Russia	98.834	5.341
Singapore	56.989	21.932
Spain	-52.174	-3.526
Sweden	37.73	6.927
Switzerland	69.538	10.524
Thailand	11.87	3.434
Turkey	-77.141	-9.962
United Kingdom	-46.578	-1.916
United States	-465.928	-3.091
Uruguay	-1.442	-3.087
Venezuela	27.205	8.597

Application: Global Imbalances

- suppose China (*) transfers T to the US
  - suppose all goods are traded
  - technology, $A(i)$, is unchanged
  - $B(i, L^*/L)$ is unchanged too, as China and the US spend T in the same way as before ($1/N$ in each good)
    - ⋆ trade balance equilibrium requires that US import - export equal the transfer

$$T = \frac{N-z}{N}(wL+T) - \frac{z}{N}(w^*L^* - T)$$

- result: no effect on w/w^* nor $z \to$ no welfare effect!

Application: Imbalances With Non-Tradeables

- suppose that goods $z < i < z^*$ are non-tradeables
  - trade balance equilibrium requires:

$$T = \frac{N - z^*}{N}(wL + T) - \frac{z}{N}(w^*L^* - T)$$

  - which implies

$$wL = \frac{z^* - z}{N - z}T + \frac{z}{N - z}w^*L^*$$

- result: the transfer increases relative demand for US goods and hence its relative wage

Application: Imbalances With Non-Tradeables

- Dekle, Eaton and Kortum (2008) take data from 2004
  - lenders (CA/GDP): China (+4%), Japan, (+3.9%), Germany (+3.8%), Norway (+14%)
  - borrowers (CA/GDP): US (-5.6%), Spain (-5.1%), Portugal (-7%), UK (-1.5%)
- calculate the wage adjustment needed to eliminate global imbalances
  - lenders (Δw): China (+1.5%), Japan, (+3.3%), Germany (+2.5%), Norway (+13%)
  - borrowers (Δw): US (-4.5%), Spain (-1.6%), Portugal (-2.5%), UK (-1.5%)
  - note: Spain's CA/GDP is by now +0.7% (wages dropped substantially)

Application: Technological Progress and Welfare

- consider the Ricardian model *à la* Eaton and Kortum
- Di Giovanni, Levchenko y Zhang (2014) quantify for 74 countries the effects of
  - uniform progress in China
  - biased progress in China (catching up with the US)
- results:
  - the world gains from a biased progress more than a uniform one (+0.42% vs 0.01%)
  - the US and almost all countries gain from China's biased progress

Technological Progress in China and Global Welfare

Panel B: Welfare Gains from Balanced Growth in China

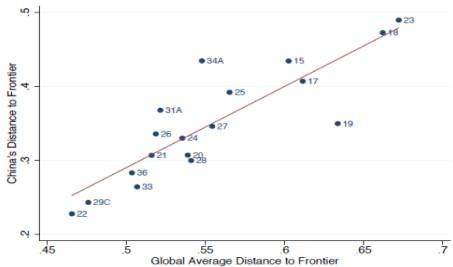
	Mean	Median	Min	Max	Countries
China	11.43				
OECD	0.01	0.02	-0.01	0.04	22
East and South Asia	0.03	0.04	-0.05	0.09	12
East. Europe and Cent. Asia	0.01	0.01	-0.02	0.06	11
Latin America and Caribbean	-0.01	0.00	-0.06	0.04	15
Middle East and North Africa	-0.01	-0.01	-0.07	0.02	6
Sub-Saharan Africa	0.00	0.01	-0.02	0.02	8

Panel C: Welfare Gains from Unbalanced Growth in China

	Mean	Median	Min	Max	Countries
China	10.57				
OECD	0.17	0.12	-0.07	0.77	22
East and South Asia	0.84	0.74	0.22	1.70	12
East. Europe and Cent. Asia	0.42	0.34	0.07	1.52	11
Latin America and Caribbean	0.50	0.49	0.09	1.68	15
Middle East and North Africa	0.48	0.52	0.19	0.77	6
Sub-Saharan Africa	0.23	0.21	-0.03	0.57	8

Technological Progress in China and Global Welfare

- why do countries benefit from China's unbalanced technical progress?
- China has a technology equal to the world average



  - if China adopts the more advanced US technology
  - world technological diversity increases $\longrightarrow$ gains for all

Taking Stock

- comparative advantage based on technological diversity
  - a country specializes in the sectors where its relative productivity more than compensates its relative wage
- trade benefits both trading partners
- trade is more beneficial for small countries
- technological progress in a country,
  - if uniform, is beneficial for both trading partners
  - if biased towards the sectors of its comparative disadvantage, may hurt the trading partner