国际经济学

技术与贸易：李嘉图模型

鲁晓东

岭南学院 中山大学

2018 年 9 月 17 日

提纲

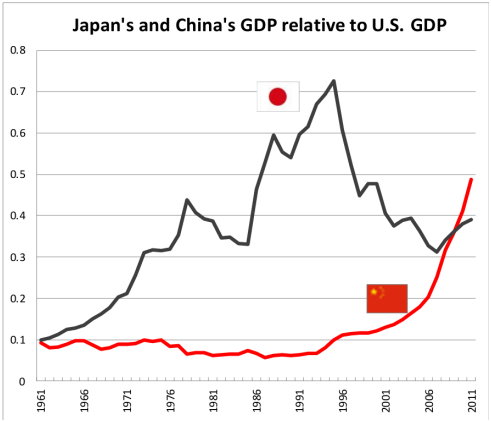
Movtivation1: 贸易的原因

Rank	Expoter	Commodity Code	Trade Value (US$)	Netweight (kg)	Percentage(%)
0	**World**	**610910**	**$3,939,487,398**	**161,316,821**	**100**
1	Honduras	610910	$541,068,929	22,156,060	13.73
2	Nicaragua	610910	$385,393,167	15,781,342	9.78
3	El Salvador	610910	$370,243,245	15,160,973	9.40
4	China	610910	$353,089,253	14,458,539	8.96
5	Dominican Rep.	610910	$299,211,186	12,252,304	7.60
6	Mexico	610910	$291,275,395	11,927,343	7.39
7	Haiti	610910	$268,398,127	10,990,549	6.81
8	Viet Nam	610910	$233,827,373	9,574,923	5.94
9	India	610910	$216,850,294	8,879,734	5.50
10	Bangladesh	610910	$194,298,280	7,956,258	4.93

- 美国完全拥有制造 T 恤衫的技术，为什么还要从洪都拉斯进口?
- 中国的纺织品生产技术是全球最高的，为什么美国还从技术落后的洪都拉斯等国进口?

Motivation2: 如何看待国家之间的经济 catchup

- 2018 年，中美贸易战发生的直接导火索是什么?
- Some foreign economies have been growing much faster than U.S.
- Partly due to population growth but also due to technological catch -up



Some Reactions

1971

2009

Enter the Ricardian Model

- Are these reactions justified?
- What is the effect of growth abroad on the U.S. economy?
- 面对其他国家的技术赶超，何种态度才是符合理性精神的?
- The Ricardian model provides the most widely used model to think about these issues conceptually

Gains from Trade: An Obvious Example

- Imagine a world with two countries (England and Portugal) producing and consuming two goods (cloth and wine)
- There are 100 workers in each country
- If England allocates all of its workers to producing...
  - cloth, they can produce 1,000 pieces of cloth
  - wine , they can produce 500 bottles of wine
- If Portugal allocates all of its workers to producing...
  - cloth, they can produce 500 pieces of cloth
  - wine , they can produce 1,000 bottles of wine

Autarky Equilibrium

- Consider an autarky equilibrium where countries can only consume what they produce
- Assume that 60 workers are employed in cloth production, 40 in wine production
- Then, England produces (and consumes) 600 pieces of cloth and 200 bottles of wine
- Portugal produces 300 pieces of cloth and 400 bottles of wine
- "World" jointly produces (and consumes) 900 pieces of cloth and 600 bottles of wine

Free Trade Equilibrium

- Suppose now that England and Portugal can freely trade across borders
- Suppose England produces only cloth and Portugal only wine
- World now jointly produces 1,000 pieces of cloth and 1,000 bottles of wine
- So world consumption goes up. There are overall gains from trade
- How are gains distributed within and across countries? Less clear: we need **a model** to determine prices

A Way to Determinate Labor Division

- The Production Possibility of the two countries

	Cloth	Wine
England	1000	500
Portugal	500	1000

- The Labor Productivity (Q_i/L_i) of the two countries

A Way to Determinate Labor Division

- The Production Possibility of the two countries

	Cloth	Wine
England	1000	500
Portugal	500	1000

- The Labor Productivity (Q_i/L_i) of the two countries

	Cloth	Wine
England	**10**	5
Portugal	5	**10**

- The Production Cost of the two countries

A Way to Determinate Labor Division

- The Production Possibility of the two countries

	Cloth	Wine
England	1000	500
Portugal	500	1000

- The Labor Productivity (Q_i/L_i) of the two countries

	Cloth	Wine
England	**10**	5
Portugal	5	**10**

- The Production Cost of the two countries

- This is the Adam Smith's intelligence! We called it **Absolute Advantage**

从绝对优势到比较优势：A Less Obvious Example

- The previous example was obvious because England had absolute advantage in producing cloth, while Portugal had absolute advantage in producing wine
- Suppose now that Portugal can only produce a maximum of 600 pieces of cloth and 400 bottles of wine
- The Production Possibility of the two countries

	Cloth	Wine
England	1000	500
Portugal	600	400

- England has **Absolute Advantage** in both goods. Does it pay for England to trade with Portugal?

An Intuitive But Wrong Answer

- England should not buy cloth or wine from Portugal because English "firms" are more productive than Portuguese "firms"
- Related modern examples (or misconceptions):
  - Less - developed economies should not follow free trade practices because these countries are not "competitive" enough
  - U.S. firms must keep their competitive edge unless they want to be wiped out from world markets

Ricardo′ s Insight

- Suppose that autarky production in England is as before (600 pieces of cloth and 200 bottles of wine)
- Portugal now produces 600 x 0.6 = 360 pieces of cloth and 400 x 0.4 = 160 bottles of wine (maintain 60/40 distribution of workers)
- So World now produces 960 pieces of cloth and 360 bottles of wine under autarky
- What happens when England produces only cloth and Portugal only wine and there is free trade?

Ricardo′ s Insight (cted.)

- World now produces 1,000 pieces of cloth and 400 bottles of wine
- Again there are aggregate gains from trade!
- Possible Equilibrium:
  - England consumes 600 pieces of cloth and 240 bottles of wine
  - Portugal consumes 400 pieces of cloth and 160 bottles of wine
- So both countries gain from trade!

Comparative Advantage I

- Countries generally find it beneficial to specialize in the production of goods that they can produce relatively (or comparatively) more efficiently
- England can produce cloth and wine more efficiently, but the advantage is relatively higher in cloth ($1{,}000/600 > 500/400$)
- Paul Samuelson: "comparative advantage is the best example of a proposition in all of the social sciences which is both true and non- trivial"
- The ways to measure comparative advantage
  - Relative labor productivity
  - Relatvie labor cost
  - Opportunity cost
    - the opportunity cost of producing something measures the cost of not being able to produce something else
- Definition: A country has a comparative advantage in producing a good if the opportunity cost of producing the good in that country is lower than it is in other countries

Measurement of Comparative Advantage

- Relative labor productivity

Measurement of Comparative Advantage

- Relative labor productivity

	Cloth/Wine	Wine/Cloth
England	**2**	0.5
Portugal	1.5	**0.66**

- Relatvie labor cost

Measurement of Comparative Advantage

- Relative labor productivity

	Cloth/Wine	Wine/Cloth
England	**2**	0.5
Portugal	1.5	**0.66**

- Relatvie labor cost

	Cloth/Wine	Wine/Cloth
England	**0.5**	2
Portugal	0.66	**1.5**

- Opportunity cost

Measurement of Comparative Advantage

- Relative labor productivity

	Cloth/Wine	Wine/Cloth
England	**2**	0.5
Portugal	1.5	**0.66**

- Relatvie labor cost

	Cloth/Wine	Wine/Cloth
England	**0.5**	2
Portugal	0.66	**1.5**

- Opportunity cost

	Cloth	Wine
England	**(1/10)*5=0.5 wine**	(1/5)*10=2 Cloth
Portugal	(1/6)*4=0.66 wine	**(1/4)*6=1.5 cloth**

David Ricardo

- Concept of comparative advantage first proposed by David Ricardo (1772-1823)
- The richest economist in history
  - made £1,000,000 in waterloo battle
- May be the first economist discriminate female and leave a bad tradition in economic field

对比较优势理论的评价

比较优势是这样一个最佳的例子，即一个经济学原理无疑是正确的，但是对于聪明的人而言却并非显而易见的。
————萨缪尔森《一个经济学家的道路》

A Formal Ricardian Model

脑洞题

你们都学过经济学原理，经济学原理中最基础的模型就是市场模型，市场模型里的价格是有什么因素决定的？你是否能想出一种情形，在这种情形下，价格由单一方面决定？

- Two -country world with a Home country and a Foreign one
- Labor is the only factor of production and is in fixed supply
- Only two goods are relevant for production and consumption (wine and cloth)
- Labor productivity varies across countries and goods (due to differences in technology)
- Labor can move freely across sectors
- There are constant returns to scale, so technology can be summarized by a unique number for each good and country
- All markets are competitive so that wine and cloth producers take prices and wages as given

Unit Labor Requirements

- Because labor productivity is constant, we can define a unit labor requirement as the constant number of units of labor required to produce one unit of output
- a_{LW} is the unit labor requirement for wine in the Home country
  - this implies that 1 unit of labor (say 1 worker) produces $1/a_{LW}$ units (say bottles) of wine
- $a_{LC}$is the unit labor requirement for cloth in the Home country
- $a*_{LC}$and $a*_{LW}$ are the analogous numbers for the Foreign country
- A high unit labor requirement hence implies a low labor productivity level

Production Possibility Frontier

The production possibility frontier (PPF) of an economy represents the maximum amount of goods that can be produced from a fixed amount of resources

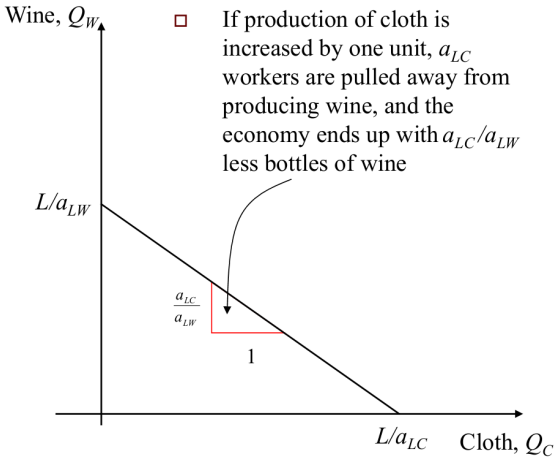
For the Home economy, we can write this as the combination of Q_C and Q_W such that

$$a_{LC}Q_C + a_{LW}Q_W = L$$

- L: Total amount of labor resources
- a_{LC}: Labor required for each unit of cloth production
- Q_C: Total units of cloth production
- a_{LW}: Labor required for each unit of wine production
- Q_W: Total units of wine production

A Graph of the PPF

- With only one factor of production and constant returns to scale, the PPF is linear in the space (Q_C, Q_W)
- The slope is given by $-(a_{LC}/a_{LW})$
- Slope measures opportunity cost of cloth in terms of wine



Autarkic Equilibrium

- So far we have discussed what an economy can produce, but
  - what will the economy actually produce?
  - what will the equilibrium wage be?
  - what will the equilibrium relative price of cloth be?
- Consider the profit maximization problem of firms in the cloth sector, that is:
  - choose Q_C to maximize $P_C Q_C - w a_{LC} Q_C$
- If $P_C > w a_{LC}$, firms would want to set $Q_C = +\infty$ (not an equilibrium)
- If $P_C < w a_{LC}$, firms would want to set $Q_C = 0$ (not an equilibrium if consumers "cannot live" without cloth)

Autarkic Equilibrium (cont.)

Hence, the only prices consistent with equilibrium are

$$P_C = wa_{LC}$$

$$P_W = wa_{LW}$$

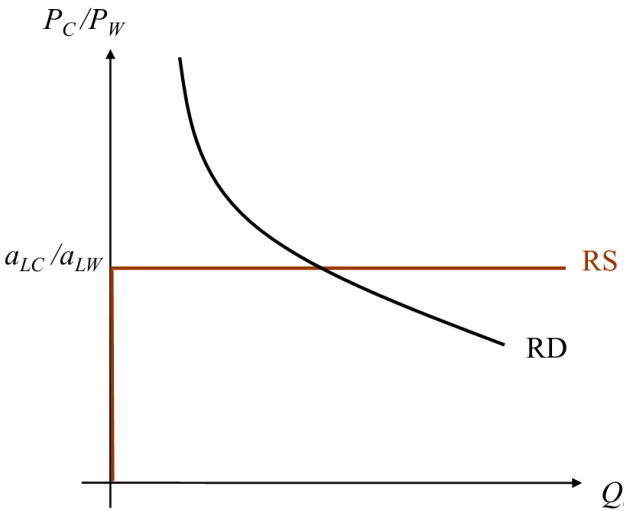
So relative prices are such that $P_C/P_W = a_{LC}/a_{LW}$
Alternative derivation:
because labor is the only factor of production, each worker receivesP_C/a_{LC} if employed in clothing, P_W/a_{LW} if employed in wine production
Only when these two numbers are equal will workers want to produce both goods
Important: with free trade, we may have $P_C/P_W \neq a_{LC}/a_{LW}$

Prices and Wages: Digression

- Hence, we have 2 equations determining 3 prices, but remember that we can always set one price at an arbitrary constant (e.g., 1)
  - If we multiply all prices and wages by a common factor, this has no effect on firm behavior or consumer behavior
- The Ricardian model is special because prices are uniquely pinned down by the supply - side of the model
- 问题：Ricardo 是如何做到这一点的?
  - labor-theory of value (classical economics)
  - generally, the demand -side of the economy will also affect value (neoclassical economics)
- What the demand-side of the model determines here is the equilibrium quantities Q_C and Q_W

Graphical Illustration of Equilibrium

- The only relative price consistent with equilibrium is a_{LC}/a_{LW}
- Relative demand determines the equilibrium relative production levels



Trade in the Ricardian Model

- Consider now a situation where Home and Foreign are allowed to trade clothing and wine with each other
- Assume that the Foreign labor force is equal to L * and that unit labor requirements in both countries satisfy

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

- This implies that under autarky:
  1. The opportunity cost of cloth in terms of wine is lower at Home than in Foreign
  2. The relative price of cloth in terms of wine is lower at Home than in Foreign
- This implies that we are assuming that Home has comparative advantage in cloth
  - Satisfies both "relative price" and "opportunity cost" definitions of comparative advantage

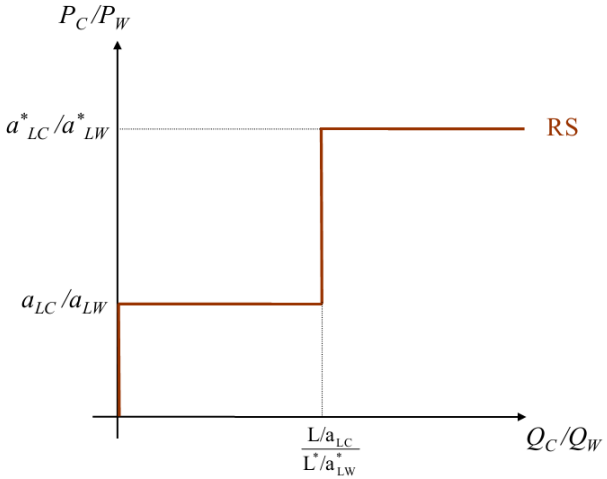
World Equilibrium

- In the free trade equilibrium, we will have that:
  1. consumers choose their demand of cloth and wine to maximize their utility;
  2. firms choose their production levels to maximize profits;
  3. world demand and supply of each good are equated;
  4. each country′ s demand and supply of labor are equated
- Main difference with autarky equilibrium is part (3), where under autarky we imposed equilibrium in each country

Profit Maximization

- Firm behavior is essentially identical to that in the autarkic equilibrium
- If $P_C/P_W < a_{LC}/a_{LW} < a^*_{LC}/a^*_{LW}$ then no firm or worker in either country would want to produce clothing
- If $P_C/P_W > a^*_{LC}/a^*_{LW} > a_{LC}/a_{LW}$ then no firm or worker in either country would want to produce wine
- What happens when $P_C/P_W = a^*_{LC}/a^*_{LW}$ or $P_C/P_W = a_{LC}/a_{LW}$?
  - Firms/workers in 1 country are indifferent between producing either good
- What happens when $a^*_{LC}/a^*_{LW} > P_C/P_W > a_{LC}/a_{LW}$?
  - Home only wants to produce cloth: $Q_C = L/a_{LC}$,$Q_W = 0$
  - Foreign only wants to produce wine: $Q_C = 0$, $Q^*_W = L^*/a^*_{LW}$

World Relative Supply

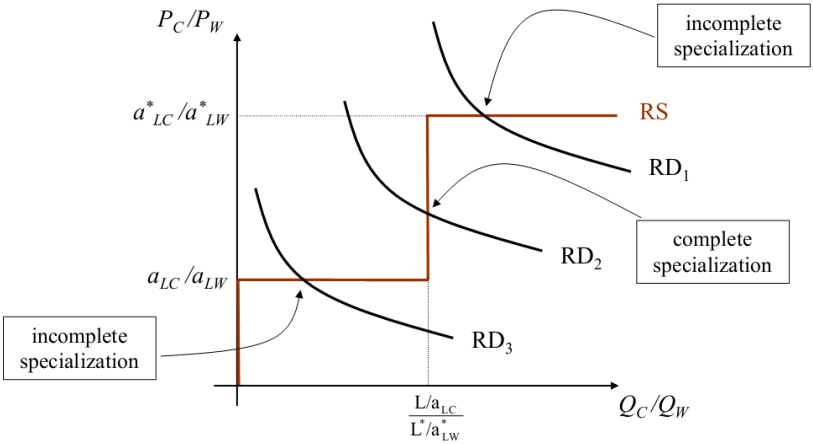


Demand Side of the Model

- Up to now we have ignored the demand side of the model
  - It did not play any role in determining relative prices under autarky
- Workers receive their wage w or w * and they spend it on clothing and food
- Assume that workers in both countries have identical homothetic preferences
  - This implies that their relative demand of the two goods is independent of wages
- Hence, the relative demand schedule is identical in both countries
- And since consumers in both countries face the same relative prices, they will also have a common relative demand

World Equilibrium

- Three possible types of equilibria



A Numerical Example

- Consider our previous example with England and Portugal, where $L = L^* = 100$
- We can represent the "tech-nology matrix" as follows $\rightarrow$
- Note that England has absolute advantage in both goods, but comparative advantage in cloth: $5/10 < 4/6$
- On the demand side, assume $U(D_C, D_W) = (D_C)^{3/5} \cdot (D_W)^{2/5}$

Unit labor requirements		
	Cloth	Wine
England	$a_{LC} = 1/10$ workers/unit	$a_{LW} = 1/5$ workers/bottle
Portugal	$a^*_{LC} = 1/6$ workers/unit	$a^*_{LW} = 1/4$ workers/bottle

A Numerical Example (cont.)

- According to related knowledge im Micro, relative demand is given by

$$\frac{D_C}{D_W} = \frac{3}{2} \cdot \frac{1}{P_C/P_W}$$

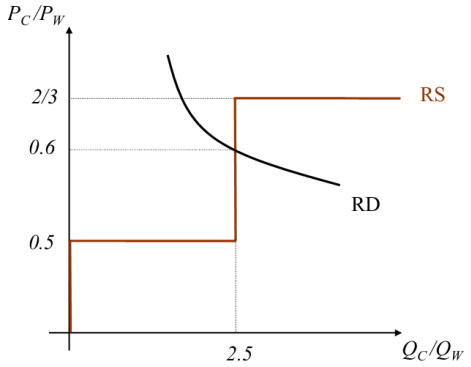
- The relative supply curve is plotted on the right

$$\frac{L/a_{LC}}{L^*/a^*_{LC}} = \frac{100/(1/10)}{100/(1/4)} = 2.5$$

- The equilibrium is:

$$P_C/P_W = 0.6$$

$$D_C/D_W = Q_C/Q_W = 2.5$$



A Numerical Example (cont.)

- We thus see that in equilibrium, England exports cloth and Portugal exports wine
- Furthermore, consistent with our suggested numbers:
  - England fully specializes in cloth and produces 1000 pieces of cloth
  - Portugal fully specializes in wine and produces 400 bottles of wine
- This implies that income in England is $1000 \cdot P_C$, which is spent on cloth ($P_C \cdot D_C$) and wine ($P_W \cdot D_W$)

A Numerical Example (cont.)

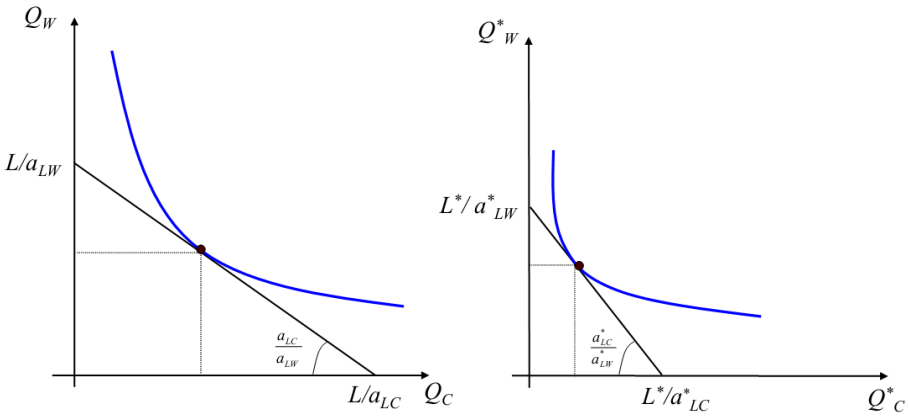
- From the demand side we also know that

$$2 \cdot P_C \cdot D_C = 3 \cdot P_W \cdot D_W$$

- We thus have $(1 + 2/3) \cdot P_C \cdot D_C = 1000 \cdot P_C \rightarrow D_C = 600$
- Using $P_C/P_W = 0.6$, we also have $D_W = 240$
- Exercise: show that $D_C^* = 400$ and $D_W^* = 160$
- Exercise: show that in autarky, $D_C = 600$ and $D_W = 200$ and $D_C^* = 360$ and $D_W^* = 160$

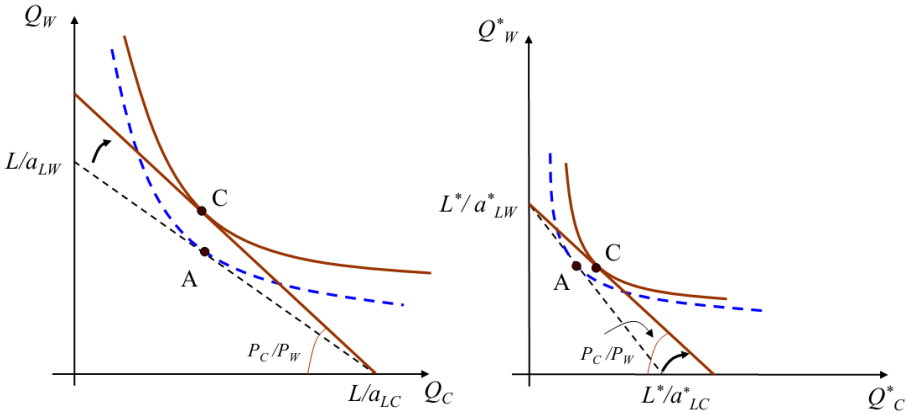
Gains From Trade: Autarky

- We can represent the autarkic equilibrium in each country as follows



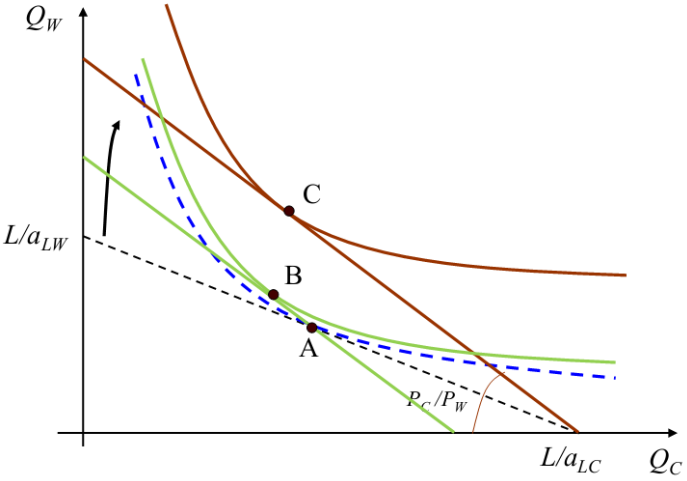
Gains From Trade: Graph

- Free trade has an effect analogous to an expansion of the PPF



Dismantle Gains: Production(Division) vs. Consumption(exchange) Gains

- There are actually two forces at play in shift from A to C
- Consumption gains from trade (A to B), as in Lecture 4
- Production gains from trade (B to C)



Distributional Effects (or lack thereof)

- The Ricardian model is extremely simple in that:
  1. All workers are identical (or units of skill are perfect subst.
  2. Workers can costlessly transition between sectors
  3. All markets are perfectly competitive and all markets clear (hence, no unemployment)
- As a result, all workers gain from trade and there is no need for redistribution
- The next two models we will present will feature distributional effects

Relative Wages

- Relative wages are the wages of the domestic country relative to the wages in the foreign country
- Although the Ricardian model predicts that goods' prices equalize across countries after trade, it does not predict that wages will do the same
- Productivity (technological) differences determine wage differences in the Ricardian model
  - A country with absolute advantage in producing a good will enjoy a higher wage in that industry after trade.

定理

比较优势决定分工（贸易）模式，绝对优势决定工资水平

证明

- Notice that regardless of the type of equilibrium, Home workers produce cloth and Foreign workers produce wine
- The wage at Home is thus equal to revenue per worker in cloth (remember zero profits), and hence$w = P_C \cdot (1/a_{LC})$
- The wage in Foreign equals revenue per worker in wine, so $w* = P_W \cdot (1/a^*_{LW})$
- The relative wage of domestic workers is therefore

$$\frac{w}{w^*} = \frac{P_C}{P_W}\frac{a^*_{LW}}{a_{LC}}$$

证明 (cont.)

- Remember that $P_C/P_W \geq a_{LC}/a_{LW}$, and hence $w/w* \geq a^*_{LW}/a_{LW}$
- Similarly, $P_C/P_W \leq a^*_{LC}/a^*_{LW}$implies that $w/w* \leq a^*_{LC}/a_{LC}$
- Putting the pieces together we have that the relative wage lies between the ratios of the two countries' productivities in the two industries:

$$a^*_{LC}/a_{LC} \geq w/w^* \geq a^*_{LW}/a_{LW}$$

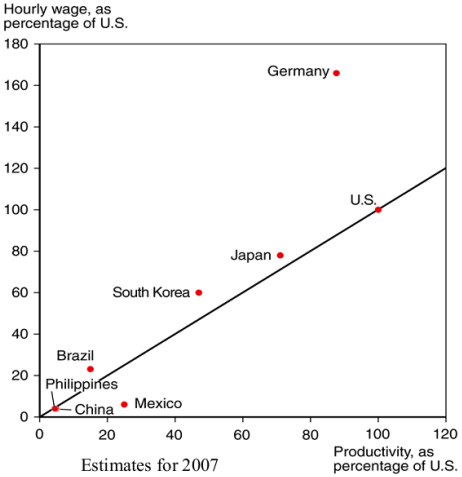
Relative Wages (cont.)

$$a^*_{LC}/a_{LC} \geq w/w^* \geq a^*_{LW}/a_{LW}$$

- If Home has absolute advantage in both industries, then $w > w*$
  - In our recurrent example, we have that $w/w* = 1.5$
- With complete specialization, $w/w*$ will fall strictly between the bounds (each countries has a cost advantage in one good)
- When both countries produce the same good, relative wages are given by the ratio of productivities in that good (absolute advantage determines wages)

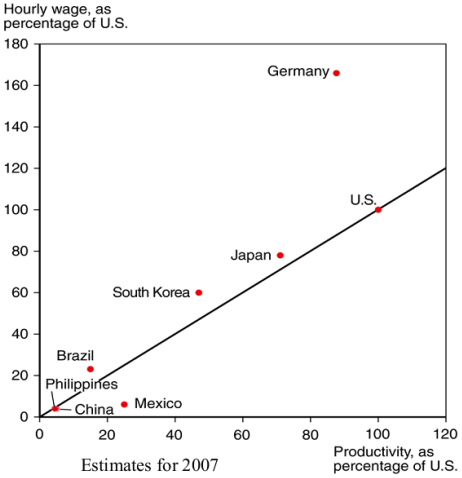
Preliminary Empirical Evidence

- In the Ricardian model, relative wages reflect the relative productivities of the two countries
- Some argue that low-wage countries pay low wages despite growing productivity, putting high -wage countries at a cost disadvantage
- What does the evidence suggest?



Preliminary Empirical Evidence

- In the Ricardian model, relative wages reflect the relative productivities of the two countries
- Some argue that low-wage countries pay low wages despite growing productivity, putting high -wage countries at a cost disadvantage
- What does the evidence suggest?



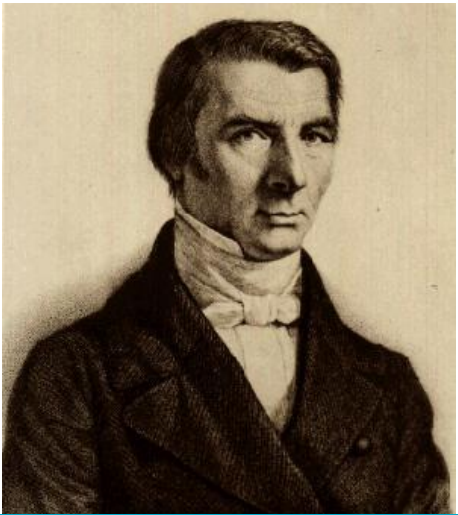
结论：生产率的提升会反映在工资增长中

Misconceptions

- We have dispelled the following misconceptions

1. Free trade can be beneficial only if a country is strong enough to stand up to foreign competition
   - gains from trade are related to comparative advantage
2. Free trade with countries that pay low wages hurts high- wage countries and is unfair
   - Free trade will lead to the dislocation of some workers, but these workers can (in principle) transition to another sector that leaves them with higher real income, due to lower relative price of imported good
   - Bastiat' s **"Petition of the Candle Makers"**
3. Free trade exploits less productive countries
   - On welfare grounds they are better off
   - What about labor standards and so on? Key question: what is the counterfactual?

Frédéric Bastiat (巴师夏，1801 -1850)



Petition of the Candle Makers

"We are suffering from the **ruinous competition** of a rival who apparently works under conditions so far superior to our own for the production of light that he is **flooding the domestic market** with it at an **incredibly low price** [...] This rival, which is none other than the sun, is waging war on us so mercilessly we suspect he is being stirred up against us by perfidious Albion (excellent diplomacy nowadays!), particularly because he has for that haughty island a respect that he does not show for us."

Petition of the Candle Makers

"We ask you to be so good as to pass a law requiring the closing of all windows, dormers, skylights, inside and outside shutters, curtains, casements, bull's- eyes, deadlights, and blinds —in short, all openings, holes, chinks, and fissures through which the light of the sun is wont to enter houses, to the detriment of the fair industries with which, we are proud to say, we have endowed the country, a country that cannot, without betraying ingratitude, abandon us today to **so unequal a combat** ."

Outline

Introducing Non -Traded Goods

- Imagine now that there is a third good, "haircuts", that can be produced both at Home and in Foreign, but that is not tradable
- A haircut requires a_{LH} units of labor at Home and a^*_{LH} in Foreign
- Suppose that preferences are such that haircuts are always produced in both countries

Equilibrium with Non -Traded Goods

- Zero profits imply $P_H = wa_{LH}$and$P_H^* = w^* a_{LH}^*$
- Now assume further that productivity differences in the production of nontradables are small, so $a_{LH} = a_{LH}^*$
- It then follows that $P_H/P_H^* = w/w^*$
- So countries with higher wages will tend to feature higher prices for "nontradables"
- And they will also feature higher aggregate price levels (since $P_C = P_C^*$ and $P_W = P_W^*$)

Balassa-Samuelson Effect

- How do non-traded goods affect the determination of world equilibrium? How is $w/w*$ determined?
- The analysis is more complicated, but it continues to be the case that relative wages are higher in countries with higher productivity levels in the production of tradable goods
- If $U(D_C, D_W, D_H) = (D_C)^a \cdot (D_W)^b \cdot (D_H)^{1-a-b}$, the solution of the model is actually almost identical to that of the model without non -traded goods
- **Balassa- Samuelson Effect:** consumer price levels in wealthier countries are systematically higher than in poorer ones because productivity levels vary more by country in the traded -good sectors than in other sectors

Some Evidence

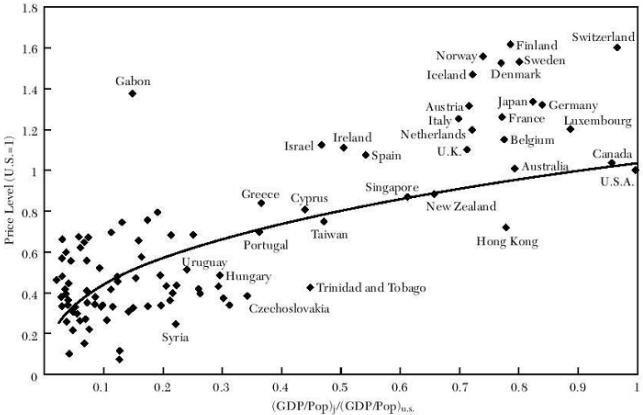
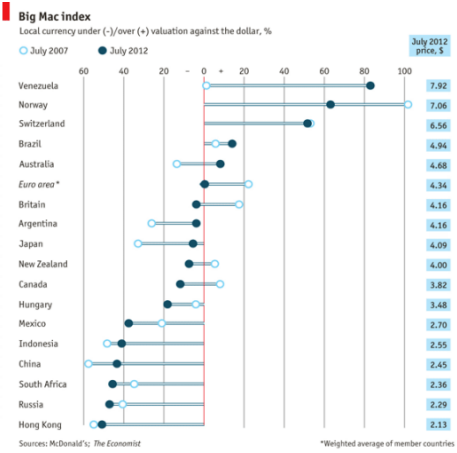


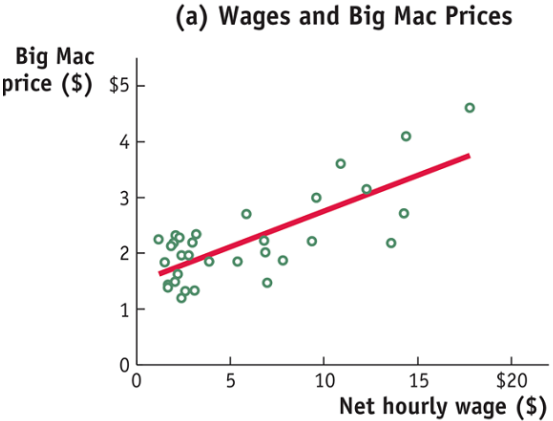
Figure 3. Price Level versus GDP per capita (U.S. = 1) $1990\ \log(P_j/P_{u.s.}) = \underset{(0.090)}{0.035} + \underset{(0.042)}{0.366}\ \log(Y_j/Y_{u.s.})$

Source: The Penn World Table, Aug. 1994

Some Implications



What's Behind the Index?



Big Mac prices vs GDP per person

Figure 22.2 Price Levels in Rich and Poor Countries
Feenstra and Taylor: International Macroeconomics, Second Edition

Transportation Costs

- Now assume that it costs $t\%$ of the price of a good to ship one unit from one country to the other
- If good i is produced in Home, then it sells for $p_i = wa_{Li}$ in Home and can be imported at price $p_i^* = (1+t)p_i$ in Foreign (to cover transport costs)
- If $w^* a_{Li}^* < (1+t)wa_{Li}$ then Foreign would not import the good, but produce it instead (even if $w^* a_{Li}^* > wa_{Li}$)
- Similarly, if $wa_{Li} < (1+t)w^* a_{Li}^*$ then Home would not import the good, but produce it instead (even if $w^* a_{Li}^* < wa_{Li}$)
- The higher the transport cost t, the more non -traded goods there will be

Outline

Introducing Multiple Goods

- Suppose now there are N tradable goods, indexed by $i = 1, 2, \ldots, N$.
- Home′ s unit labor requirement for good i is a_{Li} , Foreign′ s is a^*_{Li}
- Goods will be produced wherever it is cheaper to produce them
  - If $wa_{L1} < w^* a^*_{L1}$ then only Home country will produce good 1, since total wage payments are lower at Home

Pattern of Trade with Multiple Goods

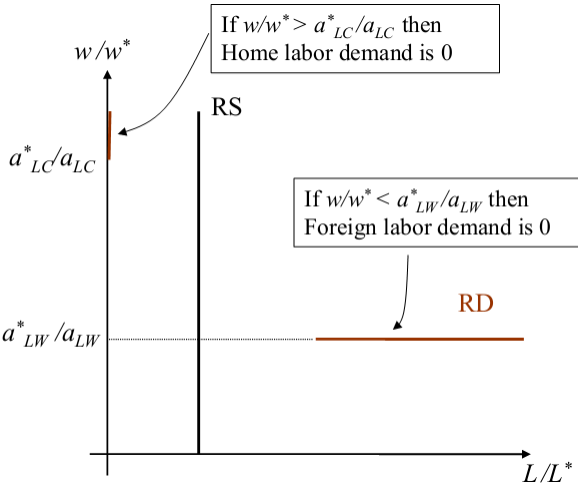
- Suppose goods are ranked such that a^*_{Li}/a_{Li} is increasing in i
  - the higher i, the larger the comparative advantage of Home
- Then we will have

$$a^*_{L1}/a_{L1} < ... < a^*_{LI}/a_{LI} \leq w/w^* \leq a^*_{LI+1}/a_{LI+1} < ... < a^*_{LN}/a_{LN}$$

- And Home produces all the goods with index $I+1$ or higher, and possibly also good I

Introducing Multiple Goods (cont.)

- How is the relative wage $w/w*$determined?
  - Relative supply and relative (derived) demand for labor are equalized
- Suppose that the relative supply is exogenous and given by $L/L*$
- The relative (derived) demand for Home labor services falls when $w/w*$ rises as Home becomes the least -cost producer of less and less goods
- Consider case of two goods



Introducing Multiple Goods (cont.)

- Note that when $L/L*$ is low, Foreign will produce both goods:

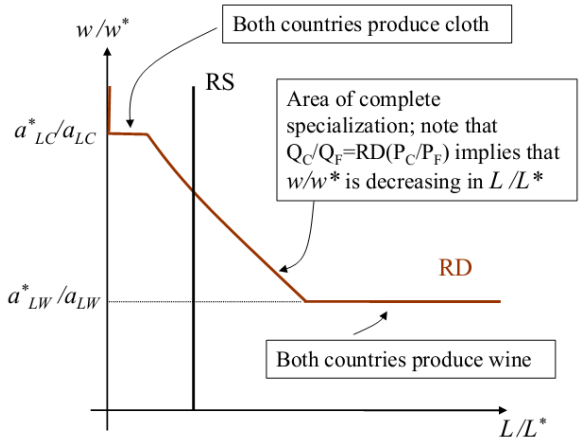
$$w/w^* = a^*_{LC}/a_{LC}$$

- Conversely, when L/L* is high, Home will produce both goods

$$w/w^* = a^*_{LW}/a_{LW}$$

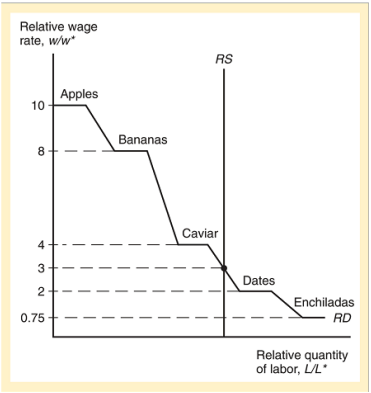
- With complete specialization:

$$w/w^* = (P_C/P_W)\cdot(a^*_{LW}/a_{LC})$$



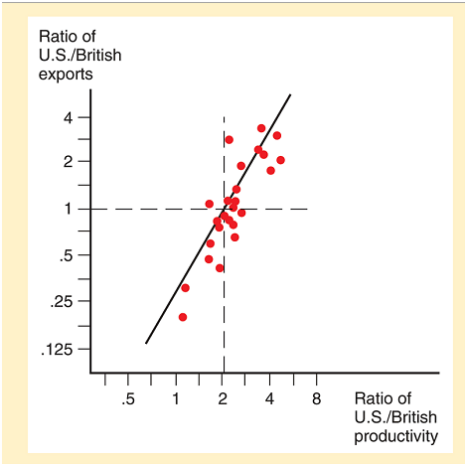
Introducing Multiple Goods (cont.)

- With multiple goods, the graph is analogous
- Note that Home and Foreign produce **at most one good in common !**
- This strong implication however crucially relies on the absence of transportation costs (see next slide)
- All countries gain from trade as long as they import a good they don' t produce



Empirical Evidence: Balassa (1963)

- Do countries export those goods in which their productivity is relatively high?
- The ratio of US to British exports in 1951 (the year of Lecture 1′ s video!) 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



Measurement of CA: Revealed comparative advantage

- The current resurgence of interest in industrial policy sometimes confronts trade economists with demands to identify sectors of comparative advantage. However, this is not a straightforward task.
- The traditional measure is the revealed comparative advantage (RCA) index (Balassa, 1965). It is a ratio of product k' s share in country i' s exports to its share in world trade. Formally

$$RCA_k^i = \frac{X_k^i / X^i}{X_k / X}$$

- A disadvantage of the RCA index is that it is asymmetric.
- Laursen (2000) normalized RCA index, say NRCA

$$NRCA_k^i = \frac{RCA_k^i - 1}{RCA_k^i + 1}$$

- the lower (-1) and upper $(+1)$ bounds are now symmetric

Conceptual Problem and Ingenious Test

- Theory predicts that countries specialize, so how would one observe the productivity of a country in a set of goods it does not produce?
- Ingenious test suggested by Costinot and Donaldson (2012) : agronomists at FAO have estimated the productivity of a given parcel of land, were it to be used to grow any one of a set of crops
- Their empirical results show that the output levels predicted by Ricardo′ s theory of comparative advantage agree reasonably well with actual data on worldwide agricultural production

Ingenious Test

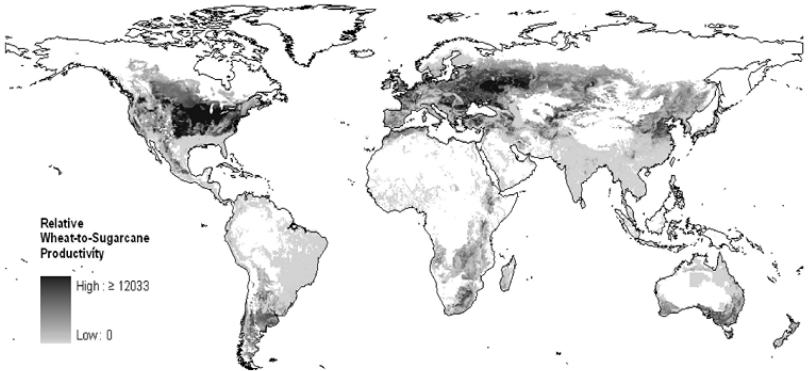
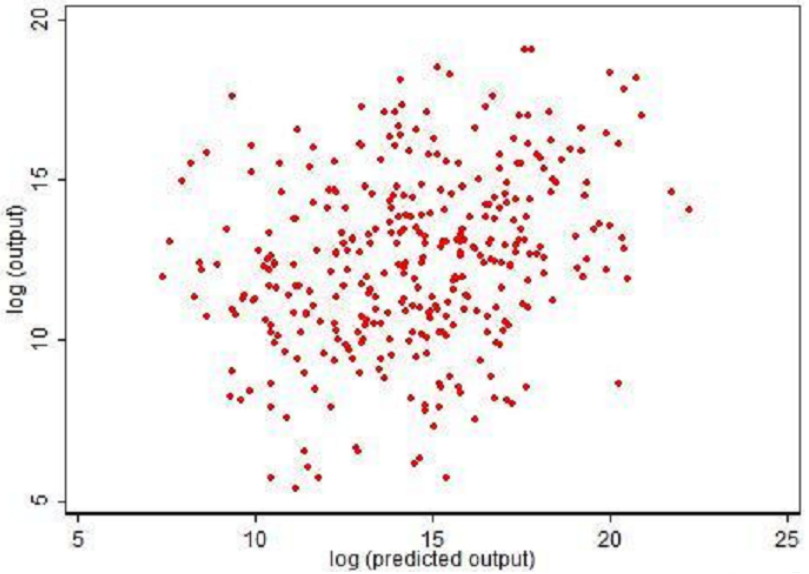


Figure 1: An Example of Relative Productivity Differences. Notes: Ratio of productivity in wheat (in tonnes/ha) relative to productivity in sugarcane (in tonnes/ha). Areas shaded white have either zero productivity in wheat, or zero productivity in both wheat and sugarcane. Areas shaded dark, with the highest value (">12,033"), have zero productivity in sugarcane and strictly positive productivity in wheat. Source: GAEZ project.


log (output)
log (predicted output)
5
10
15
20
25

Limitations of Ricardian Model

- The model ignores distributional issues, without which it is hard to make sense of protectionism
- It ignores the role of other factor endowments in determining trade flows across countries
- It ignores the role of scale economies in determining trade flows across countries

Agenda for Next Week

- Gains and Losses from Trade in the Specific-Factors Model
  - Specific Factors Model (I): Motivation. Model Assumptions and Autarky Equilibrium
  - Specific Factors Model (II): Trade Equilibrium, Distributional Conflict and Primer on Trade Policy
  - Specific Factors Model (III): An Application to the Study of Migration
- Readings:
  - K-O-M Chapter 3
  - F-T Chapter 3