The Ricardian Model, Ch3

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Introduction

- Relative Productivity, Opportunity costs and comparative advantage
- Gains from trade
- Wages and trade
- Misconceptions about comparative advantage
- Empirical evidence

The One-Factor Ricardian Model

Modeling Features

- One factor, two goods (wine & cheese), two countries (home & foreign)
- Labor is the only factor of production
  - mobile within country but immobile between countries
  - Constant labor supply in each country
  - Labor productivity varies across countries due to differences in technology
- Constant technology in each country
- Perfectly competitive markets for goods and labor

The One-Factor Ricardian Model

Mathematical expressions for the home country

Home Country

- Labor supply: L labor hours
- Technology (unit labor requirement):
  - a_{LC} labor hours per unit of cheese
  - a_{LW} labor hours per unit of cheese
- Production:
  - Q_C units of cheese
  - Q_W units of wine
- Production possibility frontier:

$$L = a_{LC} Q_C + a_{LW} Q_W \tag{1a}$$

or

$$Q_W = \frac{L}{a_{LW}} - \left(\frac{a_{LC}}{a_{LW}} \right) Q_C \tag{1b}$$

The One-Factor Ricardian Model

Mathematical expressions for the foreign country

Foreign Country

- Labor supply: L^* labor hours
- Technology (unit labor requirement):
  - a^*_{LC} labor hours per unit of cheese
  - a^*_{LW} labor hours per unit of cheese
- Production:
  - Q^*_C units of cheese
  - Q^*_W units of wine
- Production possibility frontier:

$$L^* = a^*_{LC} Q^*_C + a^*_{LW} Q^*_W \tag{2a}$$

or

$$Q^*_W = \frac{L^*}{a^*_{LW}} - \left(\frac{a^*_{LC}}{a^*_{LW}} \right) Q^*_C \tag{2b}$$

Examples: Resources and Technology

	Home	Foreign
Resources (Labor)	$L = 100$	$L^* = 100$
Cheese Technology	$a_{LC} = 0.5$	$a^*_{LC} = 1.0$
Wine Technology	$a_{LW} = 1.0$	$a^*_{LW} = 0.5$

Examples: Production Possibility Frontier

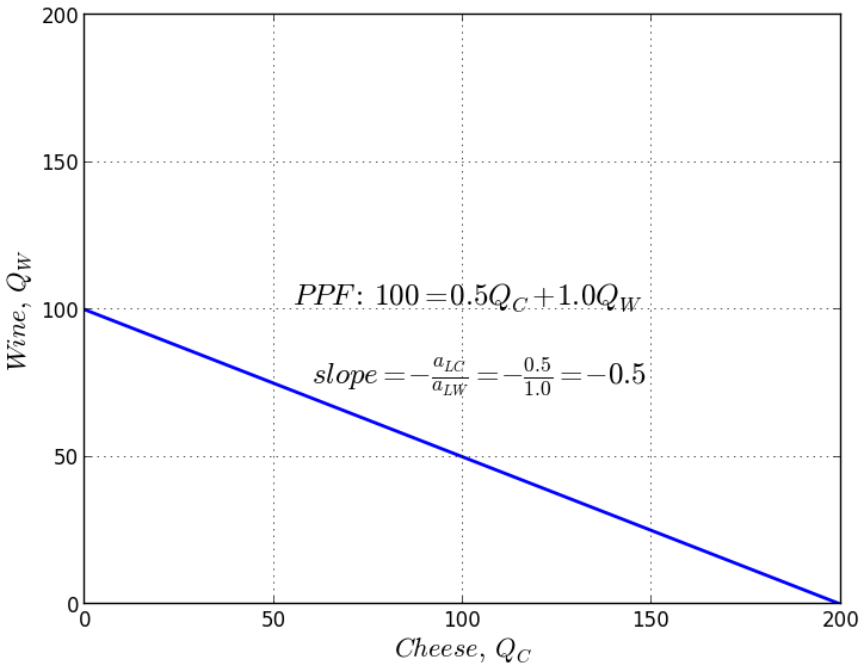

Figure 1: Home's PPF

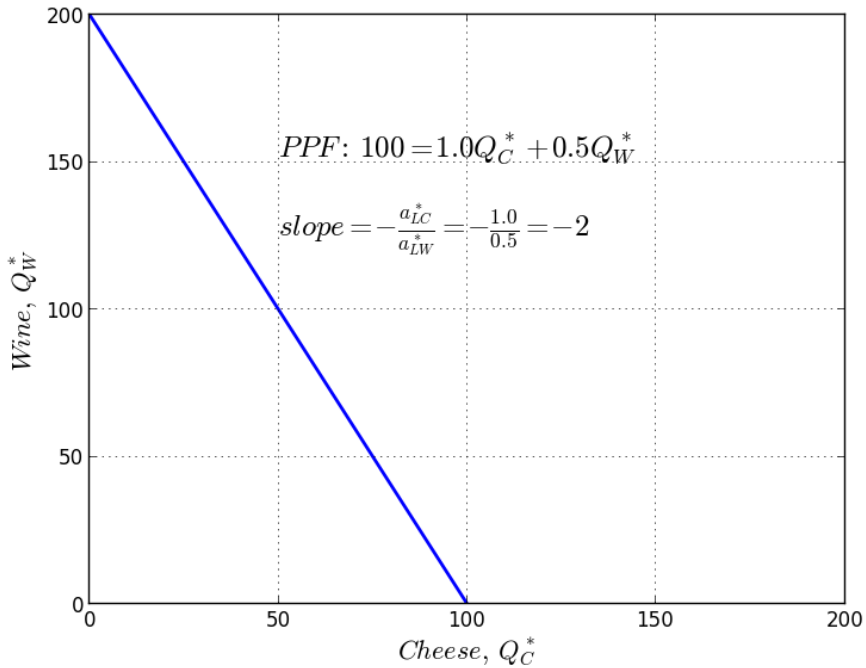

Figure 2: Foreign's PPF

Opportunity Cost

- Opportunity cost of producing 1 unit of cheese:
  - measured by $\frac{a_{LC}}{a_{LW}} = \frac{0.5}{1.0} = 0.5$
  - To produce 1 unit of cheese, Home needs to give up $\frac{a_{LC}}{a_{LW}} = 0.5$ units of wine.
- Opportunity cost of producing 1 unit of wine:
  - measured by $\frac{a_{LW}}{a_{LC}} = \frac{1.0}{0.5} = 2$
  - To produce 1 unit of wine, Home needs to give up $\frac{a_{LW}}{a_{LC}} = 2$ units of cheese.
- For Foreign:
  - $\frac{a^*_{LC}}{a^*_{LW}} = \frac{1.0}{0.5} = 2$ units of wine
  - $\frac{a^*_{LW}}{a^*_{LC}} = \frac{0.5}{1.0} = 0.5$ unit of cheese

Prices and Wages

- Home Country : Given cheese price P_C and wine price P_W, the relative price of cheese is $\frac{P_C}{P_W}$, the wage paid in the cheese industry is $wage_C = \frac{P_C}{a_{LC}}$, and the wage paid in the wine industry is $wage_W = \frac{P_W}{a_{LW}}$.
  - marginal cost of cheese is $a_{LC} wage_C$.
  - maginal cost of wine is $a_{LW} wage_W$.
  - under perfect competition, price must equal marginal cost, so $P_C = a_{LC} wage_C$ and $P_W = a_{LW} wage_W$.
- Since labor is perfectly mobile between cheese and wine industries, the wage rates must be equalized. Otherwise, all workers will flow to the industry that pays a higher wage rate, and the other industry must produce nothing.

Relative Prices and Supplies

Home Country

- Home: as before, assuming $a_{LC} = 0.5$, $a_{LW} = 1$, the opportunity cost of cheese production is $\frac{a_{LC}}{a_{LW}} = 0.5$ and the opportunity cost of wine production is $\frac{a_{LW}}{a_{LC}} = 2$.

P_C	P_W	$\frac{P_C}{P_W}$	$wage_C$	$wage_W$	Q_C	Q_W
\$2	\$0.5	4	$\frac{\$2}{0.5} = \$4$	$\frac{\$0.5}{1} = \$0.5$	$\frac{L}{a_{LC}}$	0
\$2	\$1	2	$\frac{\$2}{0.5} = \$4$	$\frac{\$1}{1} = \$1$	$\frac{L}{a_{LC}}$	0
\$2	\$2	1	$\frac{\$2}{0.5} = \$4$	$\frac{\$2}{1} = \$2$	$\frac{L}{a_{LC}}$	0
\$2	\$4	0.5	$\frac{\$2}{0.5} = \$4$	$\frac{\$4}{1} = \$4$	$[0, \frac{L}{a_{LC}}]$	$[0, \frac{L}{a_{LW}}]$
\$2	\$6	0.33	\$4	\$6	0	$\frac{L}{a_{LW}}$

Relative Prices and Supplies

Foreign Country

- Foreign: as before, assuming $a^*_{LC} = 1$, $a^*_{LW} = 0.5$, the opportunity cost of cheese production is $\frac{a^*_{LC}}{a^*_{LW}} = 2$ and the opportunity cost of wine production is $\frac{a^*_{LW}}{a^*_{LC}} = 0.5$.

P^*_C	P^*_W	$\frac{P^*_C}{P^*_W}$	$wage^*_C$	$wage^*_W$	Q^*_C	Q^*_W
\$2	\$0.5	4	$\frac{\$2}{1} = \$2$	$\frac{\$0.5}{0.5} = \$1$	$\frac{L^*}{a^*_{LC}}$	0
\$2	\$1	2	$\frac{\$2}{1} = \$2$	$\frac{\$1}{0.5} = \$2$	$[0, \frac{L^*}{a^*_{LC}}]$	$[0, \frac{L^*}{a^*_{LW}}]$
\$2	\$2	1	$\frac{\$2}{1} = \$2$	$\frac{\$2}{0.5} = \$4$	0	$\frac{L^*}{a^*_{LW}}$
\$2	\$4	0.5	\$2	\$8	0	$\frac{L^*}{a^*_{LW}}$
\$2	\$6	0.33	\$2	\$12	0	$\frac{L^*}{a^*_{LW}}$

The World's Relative Supply

- Define the world's relative supply as $RS = \frac{Q_C + Q_C^*}{Q_W + Q_W^*}$

$\frac{P_C}{P_W}$	$\frac{a_{LC}}{a_{LW}}$	$\frac{a_{LC}^*}{a_{LW}^*}$	Q_C	Q_W	Q_C^*	Q_W^*	RS
4	0.5	2	$\frac{L}{a_{LC}}$	0	$\frac{L^*}{a_{LC}^*}$	0	$+\infty$
2	0.5	2	$\frac{L}{a_{LC}}$	0	$[0, \frac{L^*}{a_{LC}^*}]$	$[0, \frac{L^*}{a_{LW}^*}]$	$[\frac{L/a_{LC}}{L^*/a_{LW}^*}, \infty]$
1	0.5	2	$\frac{L}{a_{LC}}$	0	0	$\frac{L^*}{a_{LW}^*}$	$\frac{L/a_{LC}}{L^*/a_{LW}^*}$
0.5	0.5	2	$[0, \frac{L}{a_{LC}}]$	$[0, \frac{L}{a_{LW}}]$	0	$\frac{L^*}{a_{LW}^*}$	$[0, \frac{L/a_{LC}}{L^*/a_{LW}^*}]$
0.33	0.5	2	0	$\frac{L}{a_{LW}}$	0	$\frac{L^*}{a_{LW}^*}$	0

The World's Relative Supply and Relative Demand

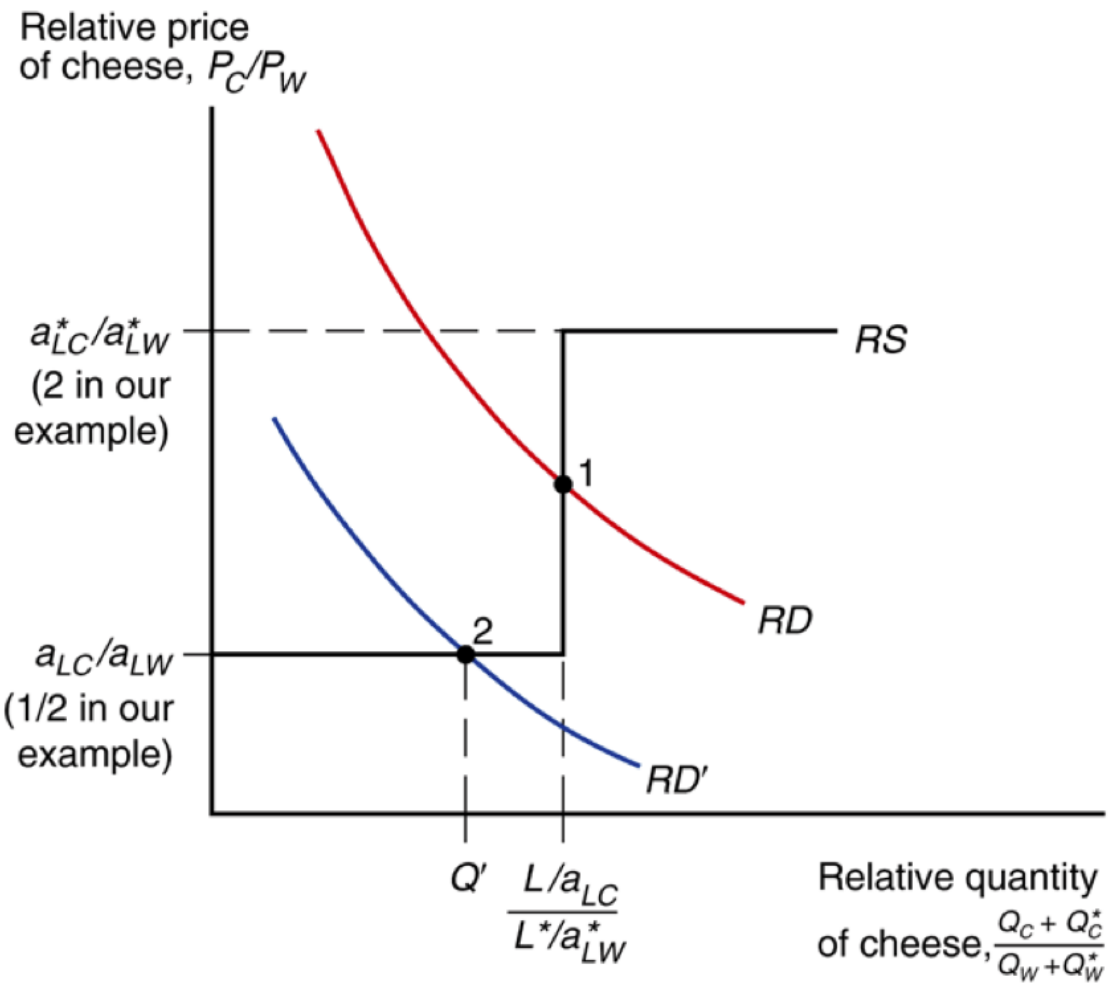

Figure 3: World Relative Supply and Demand

Relative Prices and Allocation of Resources

- How much labor is devoted to cheese or wine production in each country? This depends on relative price $\frac{P_C}{P_W}$.
- If $\frac{a_{LC}}{a_{LW}} < \frac{P_C}{P_W} < \frac{a^*_{LC}}{a^*_{LW}}$, then:
  - Home specializes in cheese production so that $Q_C = \frac{L}{a_{LC}}$, $Q_W = 0$
  - Foreign specializes in wine production so that $Q^*_C = 0$, $Q^*_W = \frac{L^*}{a^*_{LW}}$
- If $\frac{P_C}{P_W} < \frac{a_{LC}}{a_{LW}} < \frac{a^*_{LC}}{a^*_{LW}}$, then both Home and Foreign specialize in wine production.
- If $\frac{a_{LC}}{a_{LW}} < \frac{a^*_{LC}}{a^*_{LW}} < \frac{P_C}{P_W}$, then both Home and Foreign specialize in cheese production.

Relative Prices in Autarky

- In autarky, there is no international trade between Home and Foreign.
- But both cheese and wine are goods desired by consumers. So, in each country labor must be employed to produce both cheese to wine.
- Thus, in autarky, relative price must be equal to opportunity cost in each country, as implied by the RS step function. That is, using our numerical example,

$$\frac{P_C}{P_W} = \frac{a_{LC}}{a_{LW}} = \frac{0.5}{1} = 0.5$$

$$\frac{P_C^*}{P_W^*} = \frac{a_{LC}^*}{a_{LW}^*} = \frac{1}{0.5} = 2$$

- But is there any incentive for the two countries to trade?

Comparative Advantage vs. Absolute Advantage

- Comparative advantage is based on opportunity cost, which is determined determined by "relative productivity" in the Recardian model.
- In contrast, absolute advantage is based ob "absolute productivity."
- According to our numerical example,

$$\frac{a_{LC}}{a_{LW}} = \frac{0.5}{1} = 0.5 < 2 = \frac{1}{0.5} = \frac{a^*_{LC}}{a^*_{LW}}$$

- These relationships imply:
  - *Home* has a comparative advantage in cheese production, while *Foreign* has a comparative advantage in wine production. This is because the opportunity cost of cheese in smaller in Home than in Foreign (or the opportunity cost of wine is smaller in Foreign than in Home).
  - Home has an absolute advantage in cheese production, while Foreign has an absolute advantage in wine production. Why?

Pattern of Trade

- Since there are price differences in autarky, Home and Foreign will engage in international trade.
- Pattern of trade:
  - Home exports cheese to and import wine from Foreign
  - Foreign exports wine to and import cheese from Home.
- That is, comparative advantage determines the pattern of trade.
- Then what is the role of absolute advantage?

Effects of Trade on Prices

- Price effects:
  - $\frac{P_C}{P_W}$ rises in Home.
  - $\frac{P_C^*}{P_W^*}$ falls in Foreign.
  - In an integrated world market under free trade, both Home and Foreign face the same equilibrium relative price $\frac{\overline{P}_C}{\overline{P}_W}$ such that

$$\frac{a_{LC}^*}{a_{LW}^*} = \frac{P_C^*}{P_W^*} > \frac{\overline{P}_C}{\overline{P}_W} > \frac{P_C}{P_W} = \frac{a_{LC}}{a_{LW}}$$

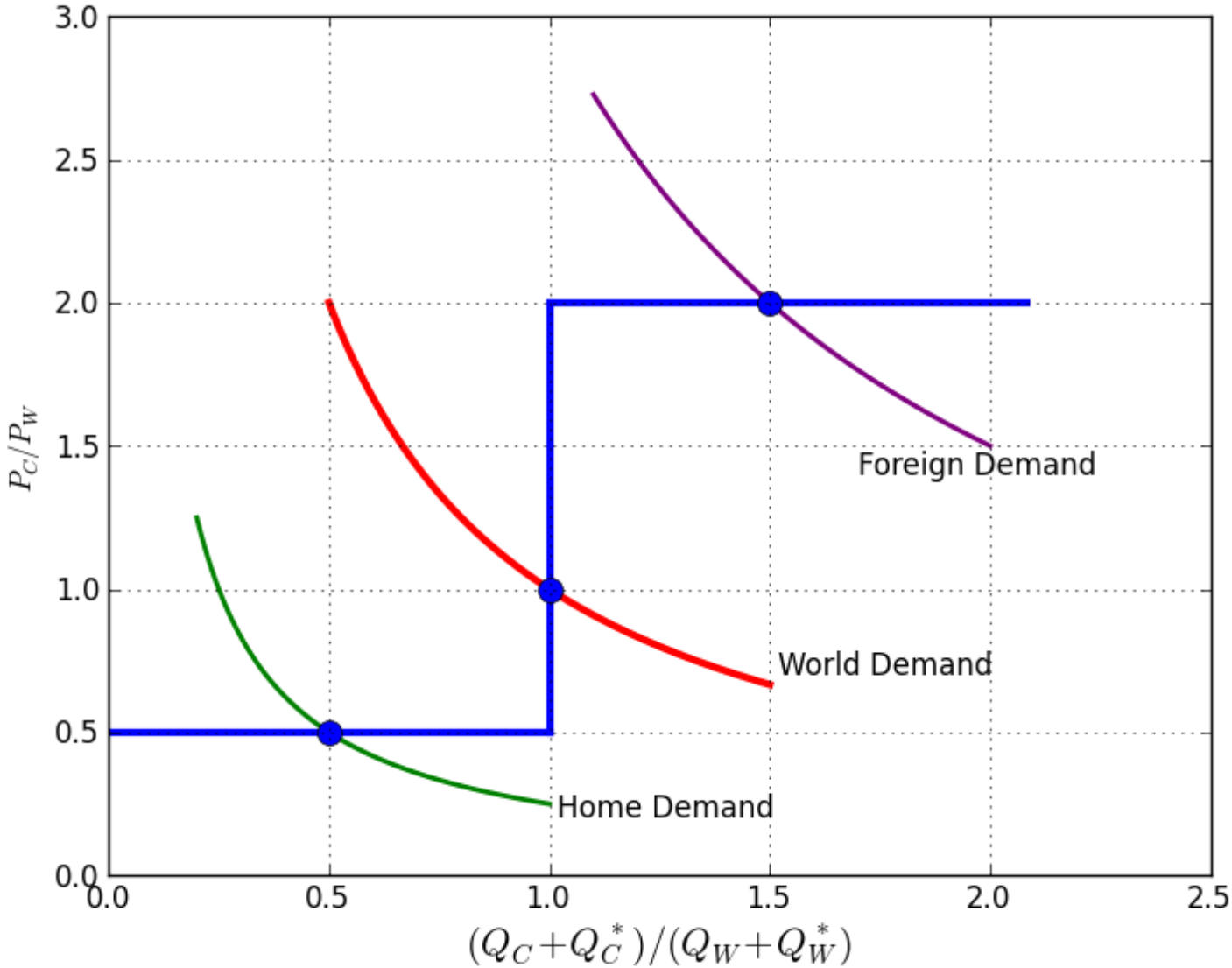

Figure 4: Effects of Free Trade on Prices

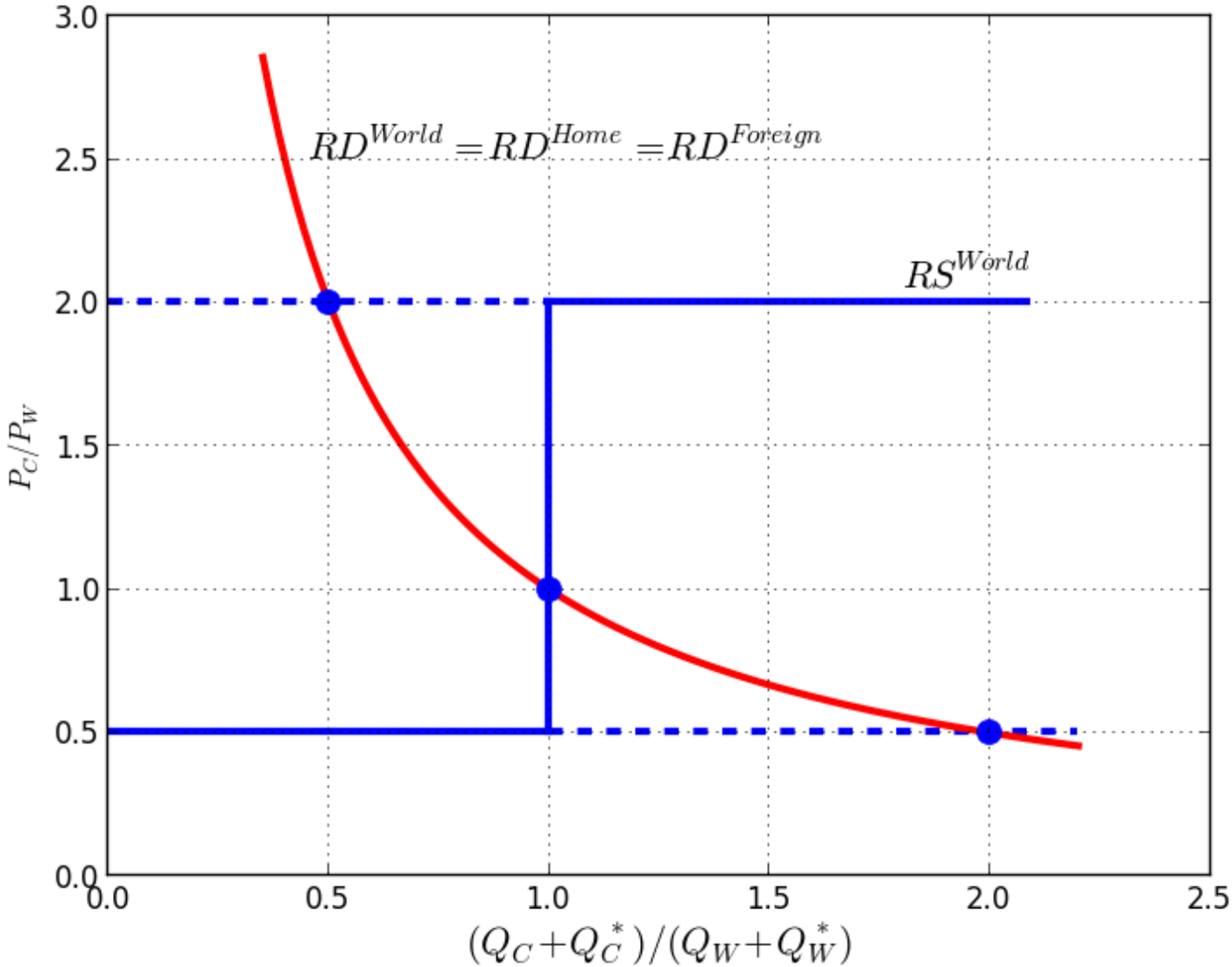

Figure 5: Effects of Free Trade on Prices: Home & Foreign have identical preferences

Effect of Trade on Resource Allocation

- Effects of resource allocation:
  - All labor is redirected into cheese (wine) production in Home (Foreign).
  - So, each country is perfectly specialized in its comparatively advantaged industry.
  - Why?

Consumption Possibilities and Gains of Trade

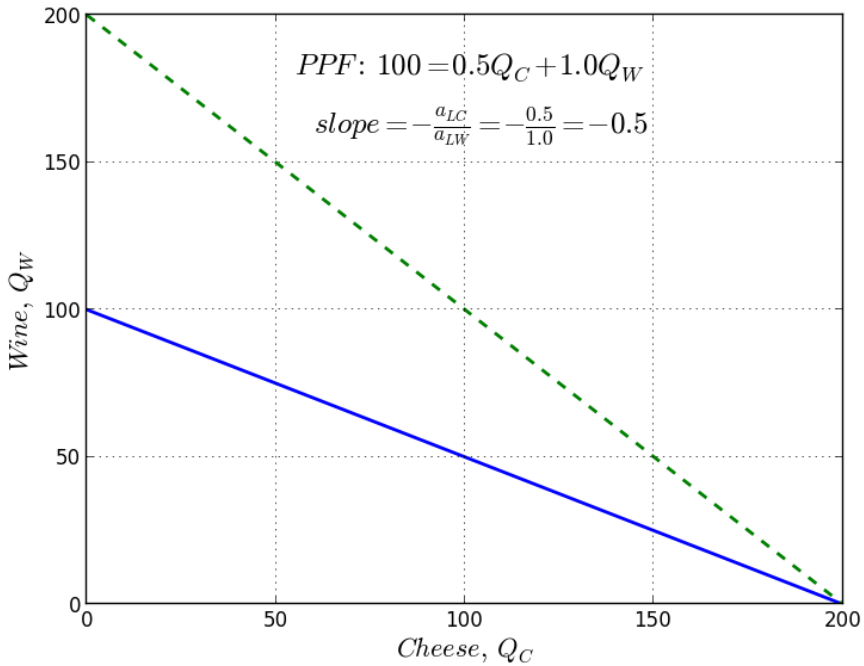

Figure 6: Home's PPF and Trade Line

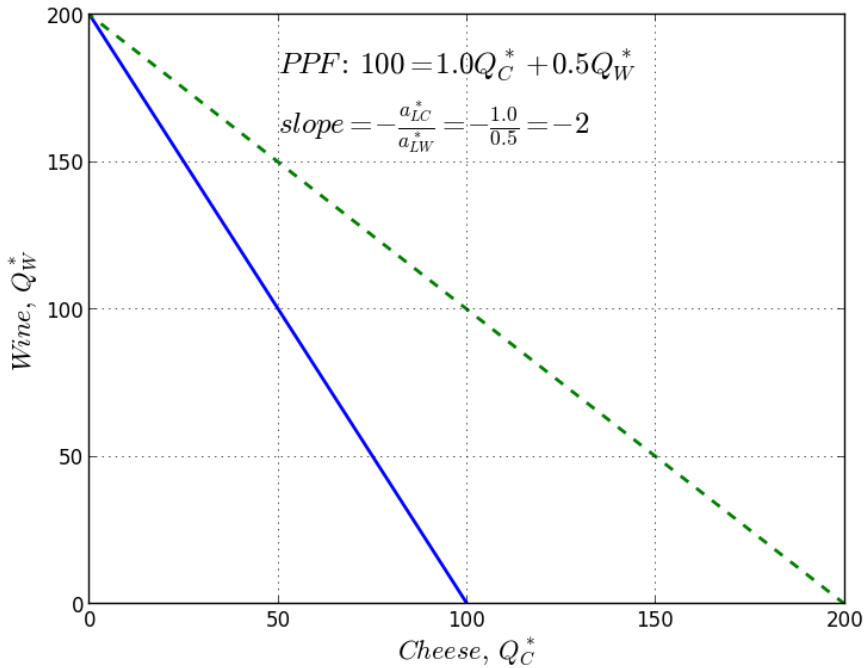

Figure 7: Foreign's PPF and Trade Line

Trade Triangle and Measuring Gains of Trade

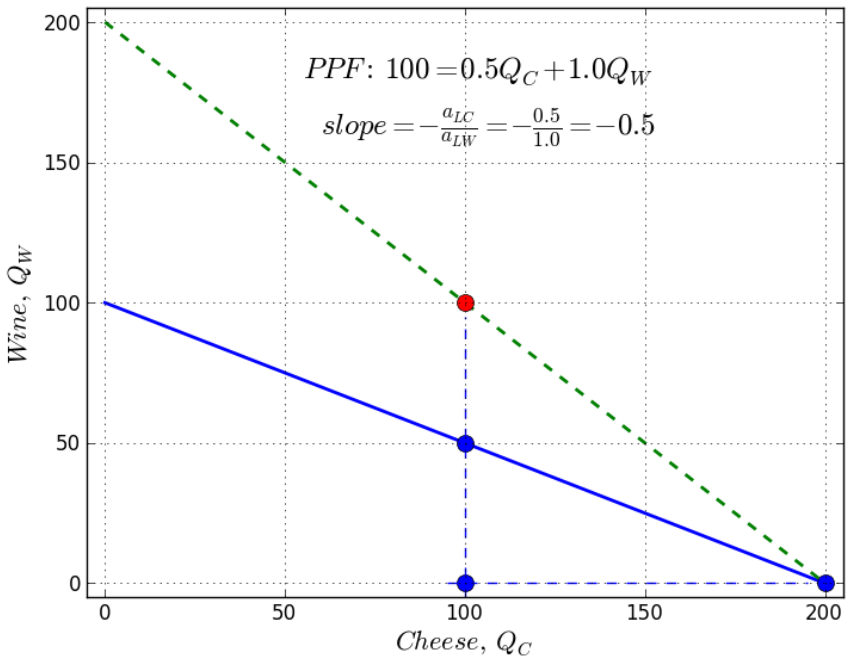

Figure 8: Home's PPF and Trade Line

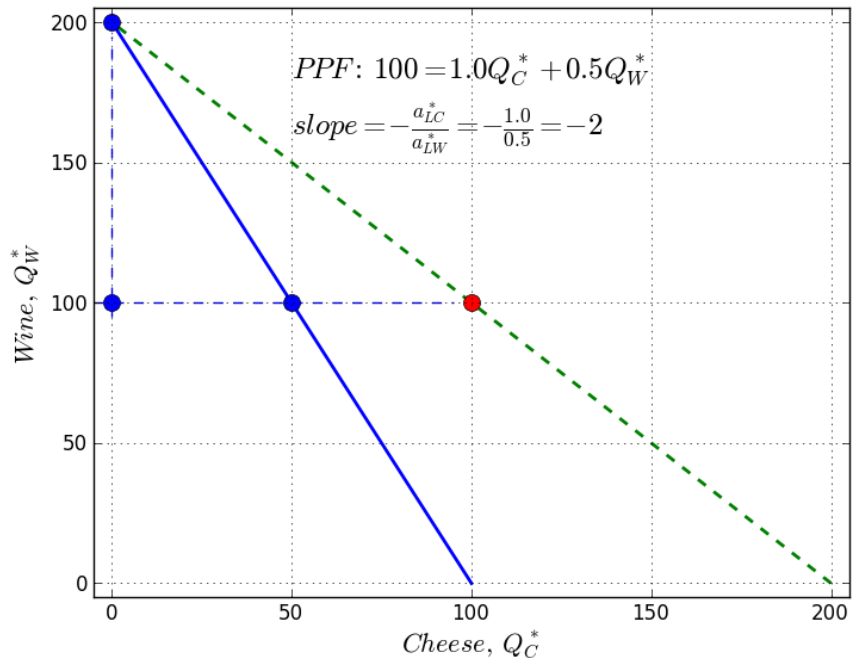

Figure 9: Foreign's PPF and Trade Line

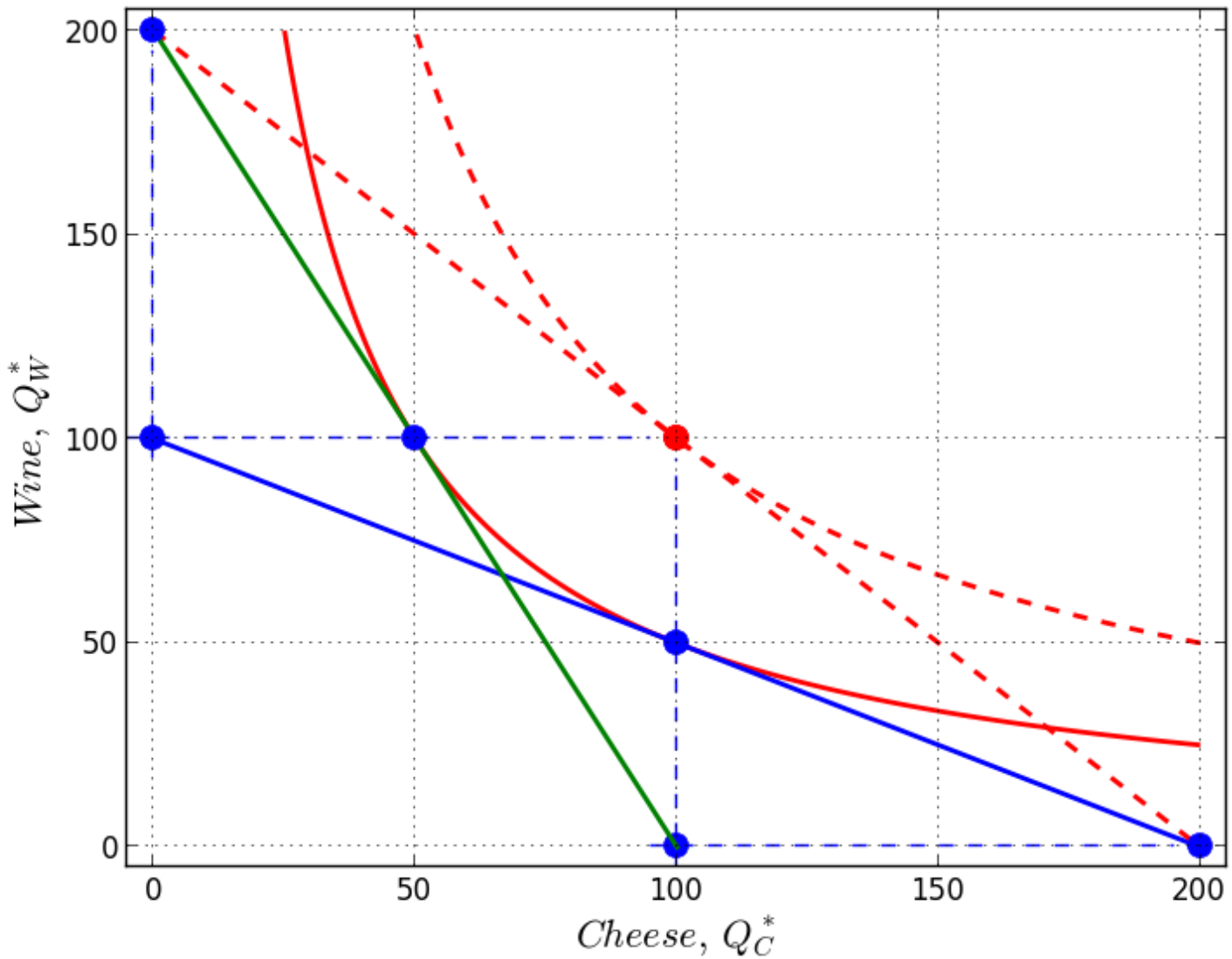

Figure 10: Effects of Free Trade on Prices: Home & Foreign have identical preferences

Relative Wage under Free Trade

- Under free trade, Home specializes in cheese and profit maximization requires

$$P_C = a_{LC} \times \text{wage}$$

- Under free trade, Foreign specializes in wine and profit maximization requires

$$P_W^* = a_{LW}^* \times \text{wage}^*$$

- Under free trade,

$$P_C = P_C^* = \overline{P}_C, \quad P_W = P_W^* = \overline{P}_W$$

- Thus, the home country's wage rate relative to the foreign country is determined by

$$\overline{P}_C = a_{LC} \times \text{wage}, \quad \overline{P}_W = a_{LW}^* \times \text{wage}^*$$

$$\begin{aligned} \frac{\text{wage}}{\text{wage}^*} &= \frac{\overline{P}_C}{\overline{P}_W} \times \frac{1/a_{LC}}{1/a_{LW}^*} = \text{Relative Price} \times \text{Relative Productivity} \\ &= 1 \quad \text{in the asssumed example} \end{aligned}$$

Empirical Evidence: Relative Wages and Productivity

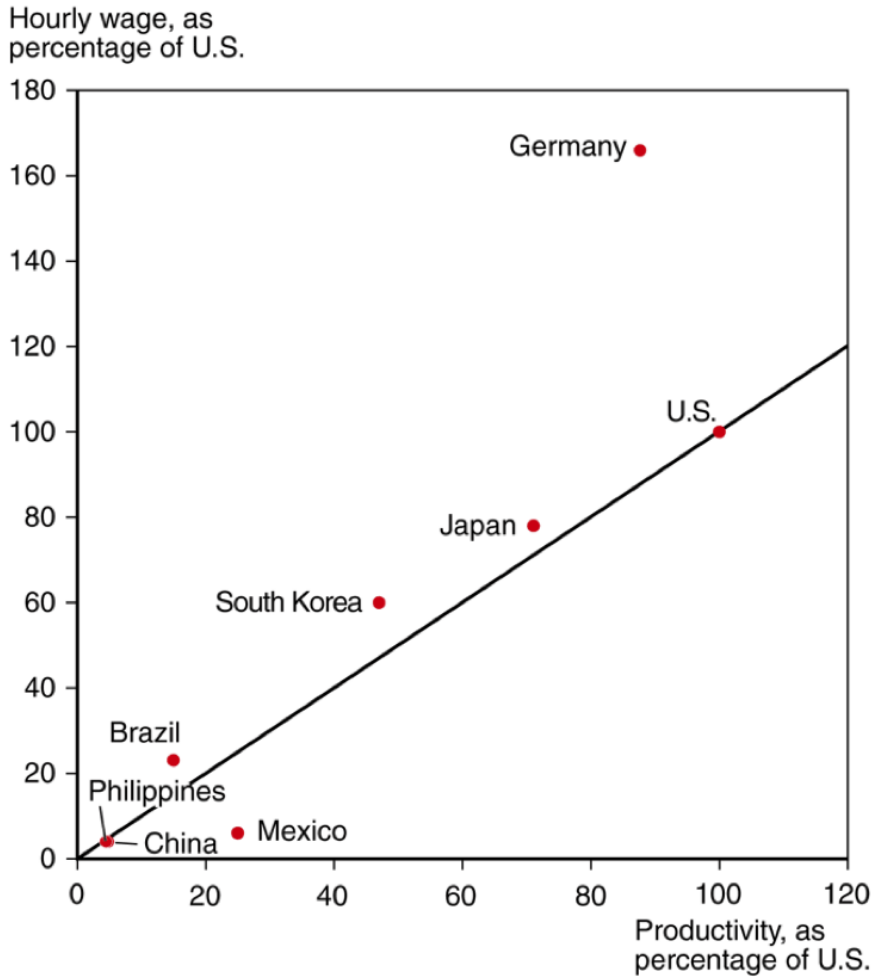

Figure 11: Relative Wages and Productivity, US = 100

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

Misconception about the Comparative Advantage

- Free trade is beneficial only if a country is more productive than foreign countries?
- Free trade with countries that pay low wages hurts high wage countries?

Do countries completely specialize in production?

- The Ricardian model predicts that countries completely specialize in production.
- But this rarely happens for three main reasons:
  - More than one factor of production reduces the tendency of specialization (Chapter 4).
  - Protectionism (Chapters 8–11).
  - Transportation costs reduce or prevent trade, which may cause each country to produce the same good or service.

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

- The ratio of U.S. to British exports in 1951, compared to the ratio of U.S. to British labor productivity in 26 manufacturing industries, suggests yes.
- At this time the U.S. had an absolute advantage in all 26 industries, yet the ratio of exports was low in the least productive sectors of the U.S.

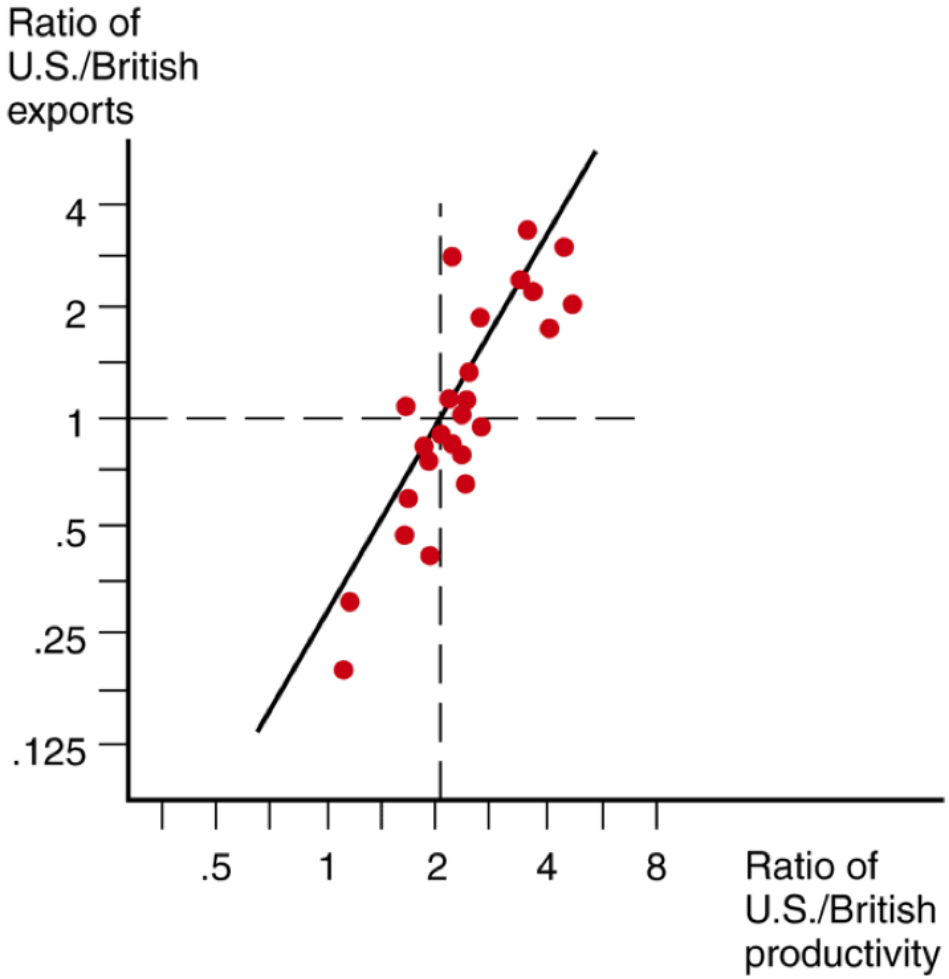

Figure 12: US Exports and Productivity

Bel Balassa. 1963. "An empirical demonstration of classical comparative cost theory," *Review of Economics and Statistics* 45: 231-238.