Topic 2 – Ricardian Trade Theory
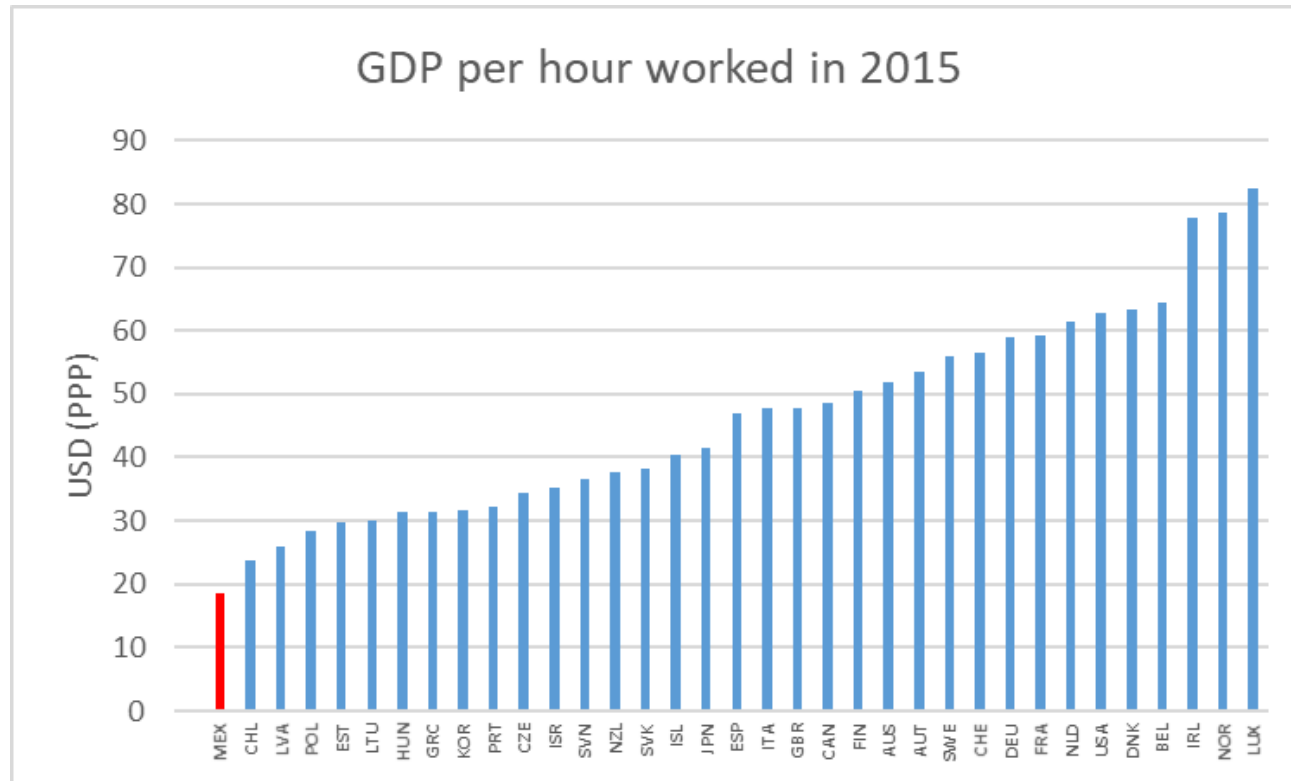
Prof. Ralph Ossa

Introduction

- How can Switzerland's export industries be competitive despite Switzerland's relatively high labor costs?

Source: OECD

Introduction (contd.)

- How can Mexico's export industries be competitive despite Mexico's relatively low labor productivity?

Source: OECD

Introduction (contd.)

- The Ricardian model explains how relative labor costs and relative labor productivity interact to determine the pattern of trade

- In my view, it is one of the most beautiful models in all of economics because it is very simple and yet delivers a number of fundamental insights (see Krugman's "Accidental Theorist" for a nice illustration of the usefulness of simple models more generally)

- It delivers two main results: (i) the pattern of trade is determined by comparative and not absolute advantage, and (ii) countries usually gain and never lose from trade

- We will derive and explain these results in the remainder of this lecture

Overview of the lecture

- Autarky

- Trade

- Gains from trade

Autarky - Setup

- A single country ("Home") produces two goods ("cheese" and "wine") from a single factor of production ("labor") under perfect competition

- It is convenient to define technologies in terms of **unit labor requirements** which are inverse measures of labor productivity:

$$L_C = a_{LC} Q_C$$
$$L_W = a_{LW} Q_W$$

- a_{LC} is the amount of labor needed to make one unit of cheese so that L_C units of labor are needed to make Q_C units of cheese (and analogously for wine)
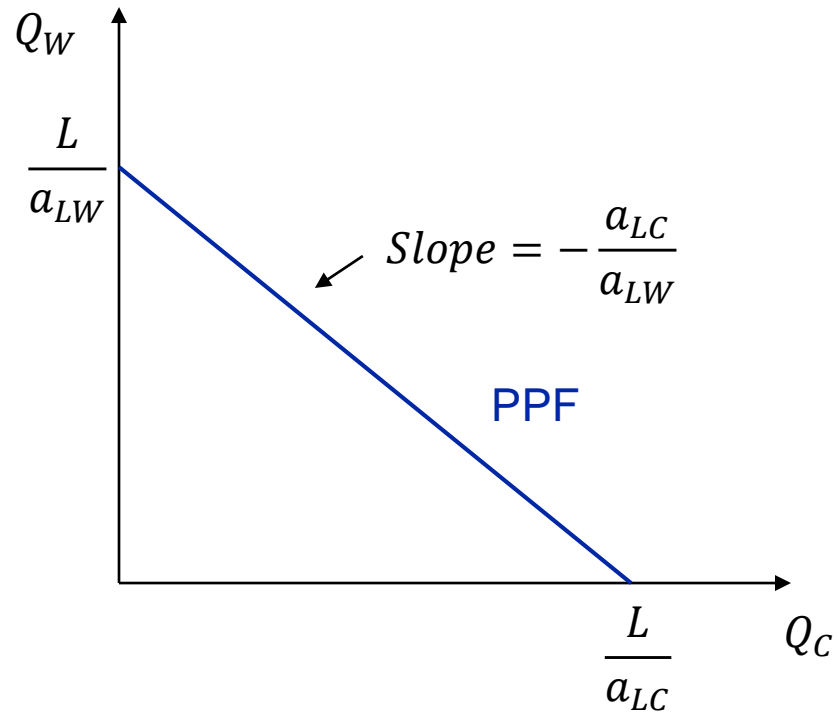
Autarky – PPF

- The **production possibilities frontier** (PPF) characterizes the maximum amount of cheese and wine the economy can produce given its available technology and resources

- Here, it is simply defined by the full employment condition $L = L_C + L_W \Leftrightarrow L = a_{LC}Q_C + a_{LW}Q_W$ which can be solved for

$$Q_W = \frac{L}{a_{LW}} - \frac{a_{LC}}{a_{LW}}Q_C$$

- Notice that it implies that the economy needs to give up $\frac{a_{LC}}{a_{LW}}$ units of wine to produce an additional unit of cheese so that $\frac{a_{LC}}{a_{LW}}$ is the opportunity cost of cheese in terms of wine

- The **opportunity cost** of producing more of one good is the required reduction in the production of the other good

Autarky – PPF (contd.)

Q_W

$\dfrac{L}{a_{LW}}$

$Slope = -\dfrac{a_{LC}}{a_{LW}}$

PPF

$\dfrac{L}{a_{LC}}$

Q_C

Clicker question:

What happens to the PPF if Home's cheese productivity increases?

Autarky – Prices and wages

- We assume that wages adjust to ensure full employment which immediately implies that the economy produces on the PPF. This assumption is more reasonable than it may seem and we will discuss it in detail in a future lecture

- However, we still need to determine where on the PPF the economy produces which amounts to determining the allocation of workers to industries. We assume that workers are fully mobile between industries and work wherever they are offered the highest wage

- The **break-even condition** in the cheese industry is $P_C = a_{LC} w_C$, where P_C is the cheese price and w_C the cheese wage, since it sets price equal to average costs. Analogously, the break-even condition in the wine industry is $P_W = a_{LW} w_W$. They implicitly define the break-even wages in both industries

Autarky – Relative supply

- It is useful to characterize the supply side of the model by a **relative supply curve** which describes how the relative supply of cheese, $\frac{Q_C}{Q_W}$, varies with the relative cheese price, $\frac{P_C}{P_W}$

- It can be constructed by determining which industry can afford to pay the highest wages for any given relative cheese price. The above break-even conditions reveal that there are three simple cases:

Case 1: $w_C < w_W \iff \frac{P_C}{P_W} < \frac{a_{LC}}{a_{LW}} \iff \frac{Q_C}{Q_W} = 0$ (Economy produces only wine)

Case 2: $w_C = w_W \iff \frac{P_C}{P_W} = \frac{a_{LC}}{a_{LW}} \iff \frac{Q_C}{Q_W} \in [0, \infty]$ (Economy produces cheese and wine)

Case 3: $w_C > w_W \iff \frac{P_C}{P_W} > \frac{a_{LC}}{a_{LW}} \iff \frac{Q_C}{Q_W} = \infty$ (Economy produces only cheese)

- Hence, the economy specializes in cheese (wine) if the relative cheese price is larger (smaller) than the opportunity cost of cheese production and produces both goods only in a knife edge case

Autarky – Relative supply (contd.)
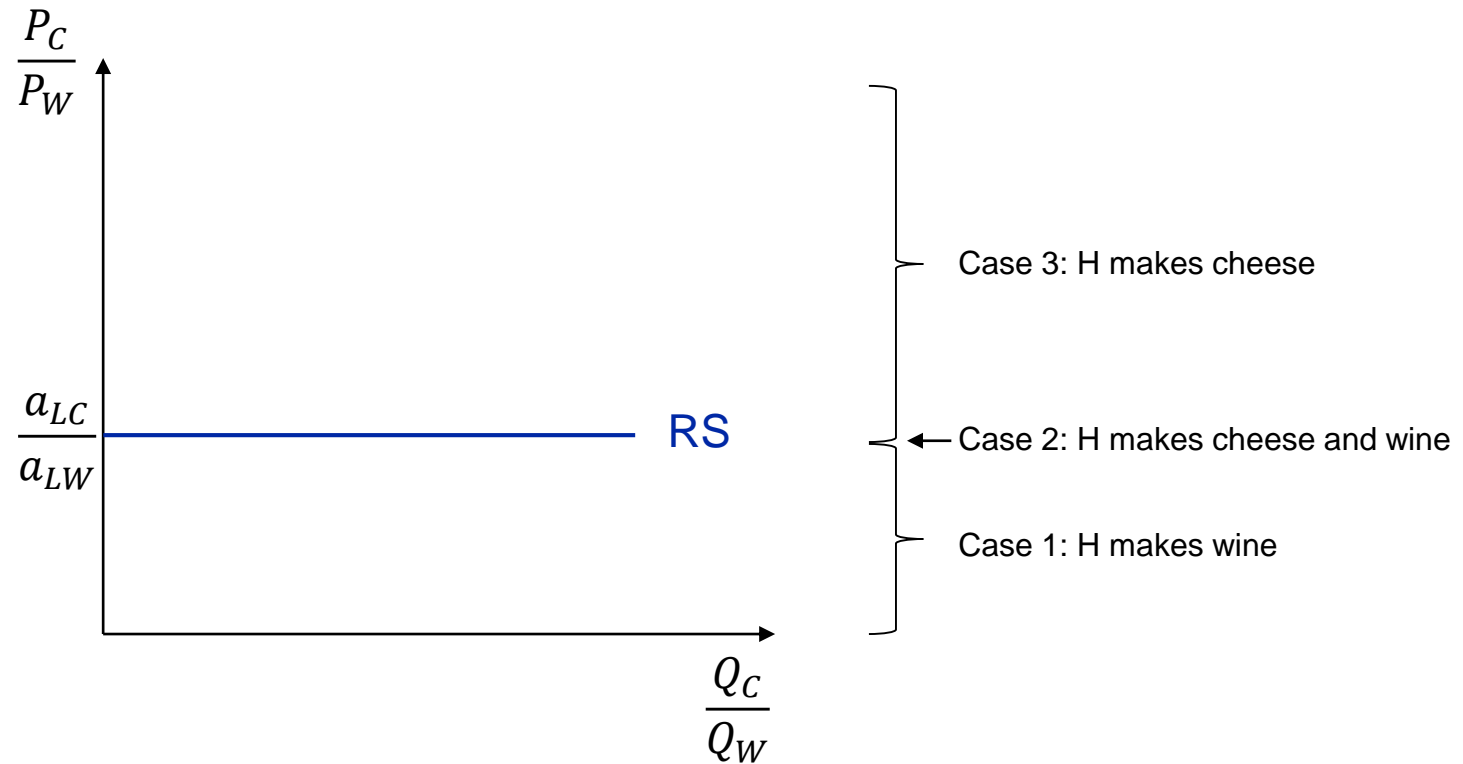
Autarky – Relative demand

- To close the model, we add a **relative demand curve** which describes how the relative demand of cheese, $\frac{Q_C}{Q_W}$, varies with the relative cheese price, $\frac{P_C}{P_W}$

- We assume that the relative demand curve is downward sloping since substitution effects are likely to make the relative demand fall as the relative price goes up

- The exact shape of the relative demand curve depends on the specification of preferences and you will be asked to work out a concrete example in the problem set

- However, the main results of the Ricardian model do not depend on the exact shape of the relative demand curve so we only impose that it is downward sloping for now

Autarky – Equilibrium
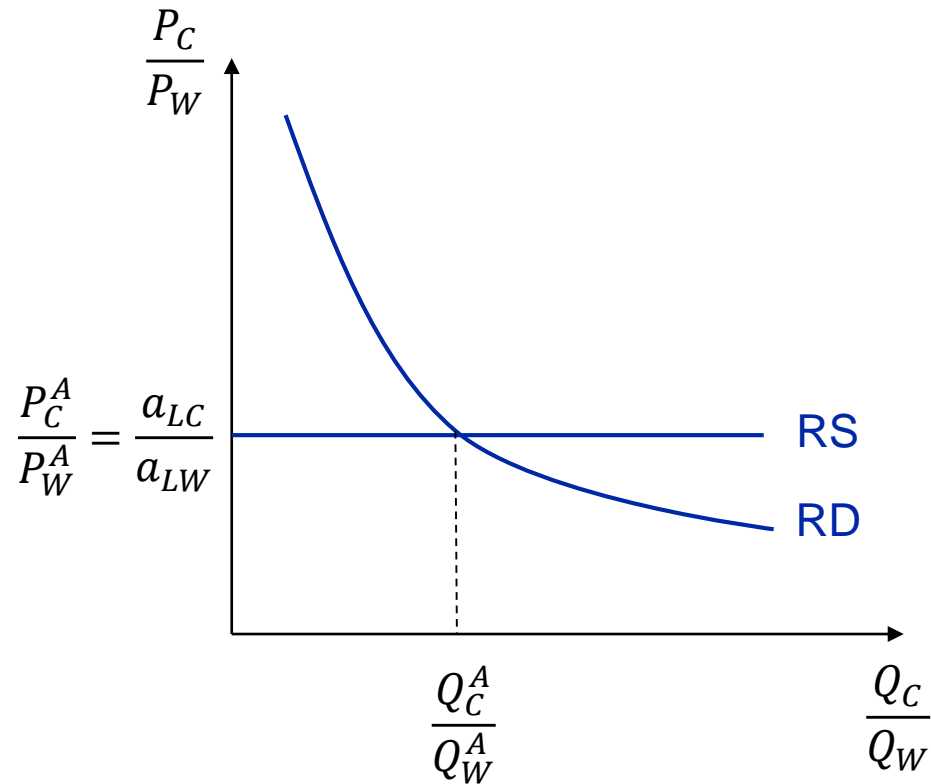
Clicker question:

How does the wage in the cheese industry compare to the wage in the wine industry in the autarky equilibrium?

Autarky – Equilibrium (contd.)

- Hence, the equilibrium relative cheese price equals the opportunity cost of cheese production under autarky

- This is because prices must adjust to ensure that wages are equal in the wine and the cheese industries so that both wine and cheese are produced

- The RS/RD diagram immediately yields the equilibrium relative cheese price, $\frac{P_C^A}{P_W^A}$, and the equilibrium relative cheese production, $\frac{Q_C^A}{Q_W^A}$ (with superscript "A" for autarky)

- The equilibrium outputs Q_C^A and Q_W^A can then be read off of the PPF which can, in turn, be used to back out the equilibrium employments L_C^A and L_W^A from the conditions $L_C = a_{LC} Q_C$ and $L_W = a_{LW} Q_W$

Autarky – Equilibrium (contd.)
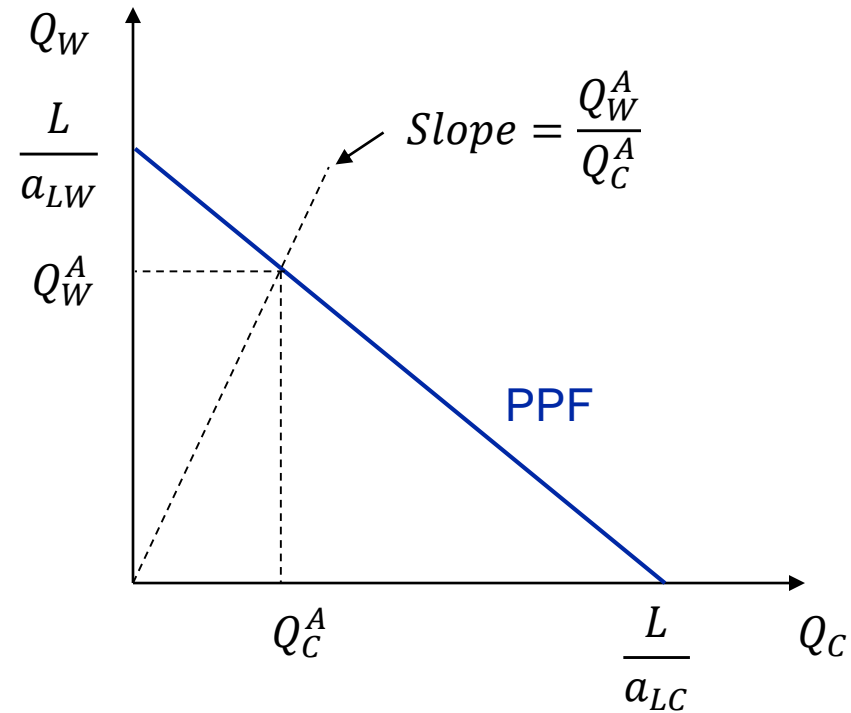
Trade - Setup

- We now extend the earlier model by introducing a second country ("Foreign") with which Home can freely trade (we rule out migration)

- We denote all Foreign variables with an asterisk "*" and allow the countries to differ in terms of their labor endowments and unit labor requirements

- We say that Home has an **absolute advantage** in cheese production if $a_{LC} < a_{LC}^*$ (and analogously for wine). We say that Home has a **comparative advantage** in cheese production if $\frac{a_{LC}}{a_{LW}} < \frac{a_{LC}^*}{a_{LW}^*}$

- We assume that Home has a comparative advantage in cheese production but take no stance on whether or not it has an absolute advantage in cheese or wine production

Trade – Absolute and comparative advantage

- In words, Home has an absolute advantage in cheese production if it has the higher cheese productivity (and analogously for wine)

- Home has a comparative advantage in cheese production if it has the lower opportunity cost of cheese production

- Notice that having an absolute advantage is neither necessary nor sufficient for having a comparative advantage

- Notice also that no country can ever have a comparative advantage in both industries. If Home has a comparative advantage in cheese production, Foreign must have a comparative advantage in wine production

Clicker question:

Knowledge of the slopes of Home's and Foreign's PPFs is sufficient to determine which country has a comparative advantage in which industry?

Trade – A first look at the pattern of trade

- Under free trade, prices must converge to rule out arbitrage opportunities so that cheese and wine cost the same in Home and Foreign. This implies that the free trade relative cheese price (with superscript "T" for trade) must be in between Home's and Foreign's autarky relative cheese prices:

$$\frac{P_C^A}{P_W^A} = \frac{a_{LC}}{a_{LW}} \leq \frac{P_C^T}{P_W^T} \leq \frac{P_C^{*A}}{P_W^{*A}} = \frac{a_{LC}^*}{a_{LW}^*}$$

- Upon opening up to trade, the relative cheese price in Home rises thereby increasing relative cheese supply and decreasing relative cheese demand. Conversely, the relative cheese price in Foreign falls thereby decreasing relative cheese supply and increasing relative cheese demand

- This results in an excess supply of cheese and an excess demand for wine in Home, and an excess demand for cheese and an excess supply of wine in Foreign, which is settled through international trade. Hence, countries export the goods in which they have a comparative advantage
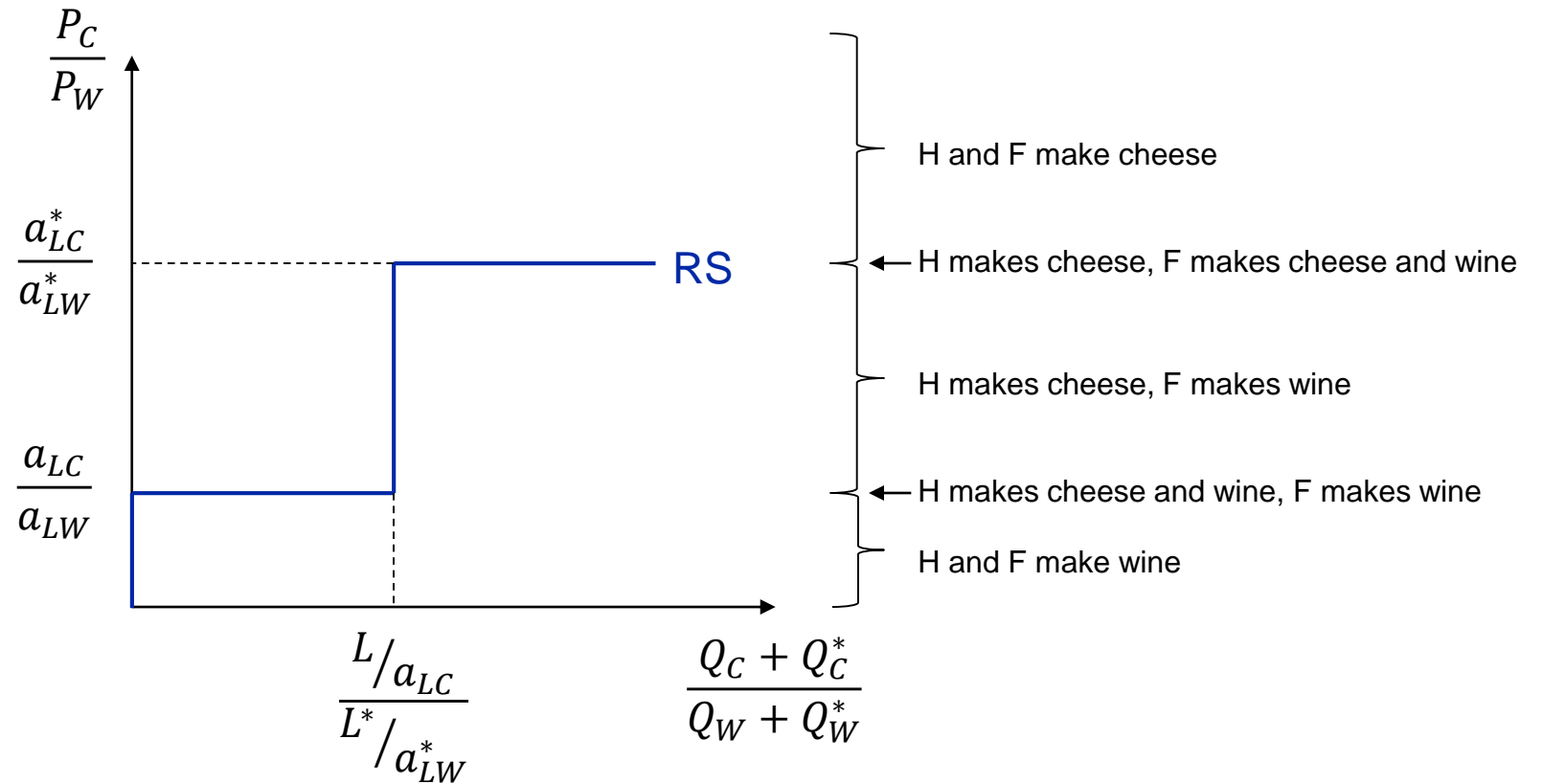
Trade – Relative supply

- To see this more formally, we now consider the world relative supply curve which describes how the world relative supply of cheese, $\frac{Q_C + Q_C^*}{Q_W + Q_W^*}$, varies with the relative cheese price, $\frac{P_C}{P_W}$

- It can be constructed analogously to the autarky relative supply curves since $w_C \gtrless w_W \Leftrightarrow \frac{P_C}{P_W} \gtrless \frac{a_{LC}}{a_{LW}}$ in Home and $w_C^* \gtrless w_W^* \Leftrightarrow \frac{P_C}{P_W} \gtrless \frac{a_{LC}^*}{a_{LW}^*}$ in Foreign

- As should be easy to verify, there are now five cases instead of three cases which gives rise to the step function on the next slide

Trade – Relative supply (contd.)

Trade – Relative demand

- To close the model, we now add a world relative demand curve which describes how the relative world demand for cheese, $\frac{Q_C + Q_C^*}{Q_W + Q_W^*}$, varies with the relative cheese price, $\frac{P_C}{P_W}$

- The world relative demand curve is the same as Home's and Foreign's relative demand curves if preferences are identical and homothetic (you will see an example of this in the problem set)

- Homothetic just means that relative demand does not vary with income (a counterexample would be that people spend relatively less on food the richer they get)

- We will make both these assumptions in the following to isolate the effects of technology. There is an interesting recent literature examining how non-homotheticities affect trade

Trade – Equilibrium (contd.)
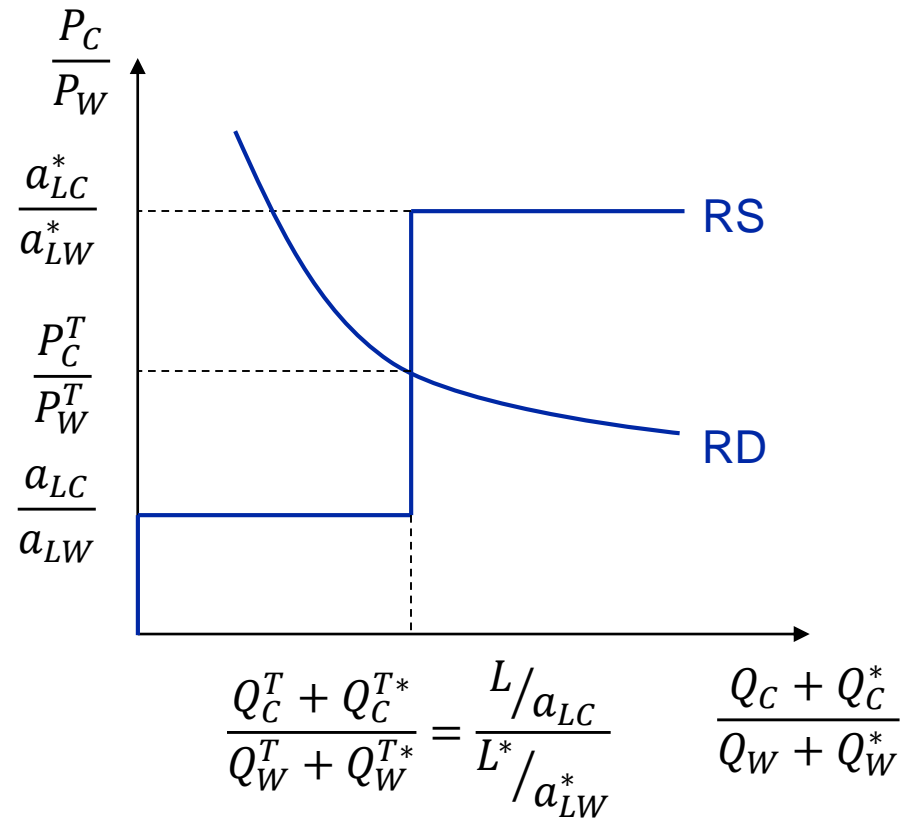
Trade – Equilibrium (contd.)

-   As can be seen, the trade relative cheese price is indeed between the two countries' autarky relative cheese prices

-   Home fully specializes in cheese and Foreign fully specializes in wine so that Home exports cheese and imports wine while Foreign imports cheese and exports wine

-   This is the first main result of the Ricardian model: countries export the goods in which they have a comparative advantage and import the goods in which they have a comparative disadvantage

-   Notice that this is not at all an obvious result since it implies that absolute advantage is irrelevant for the pattern of trade

Trade – Equilibrium (contd.)

- In the previous diagram, we have assumed that the RD curve intersects the RS curve in its vertical portion and we will take this case to be the standard one

- However, the RD curve can also intersect the RS curve in either of its vertical portions. This happens, for example, if one country is much smaller than the other one ($L \ll L^*$ or $L \gg L^*$)

- If RD intersects RS in the lower vertical portion, Home makes cheese and wine while Foreign fully specializes in cheese. If RD intersects RS in the upper vertical portion, Home fully specializes in cheese while Foreign still makes cheese and wine

- In any case, countries still export the goods in which they have a comparative advantage and import the goods in which they have a comparative disadvantage
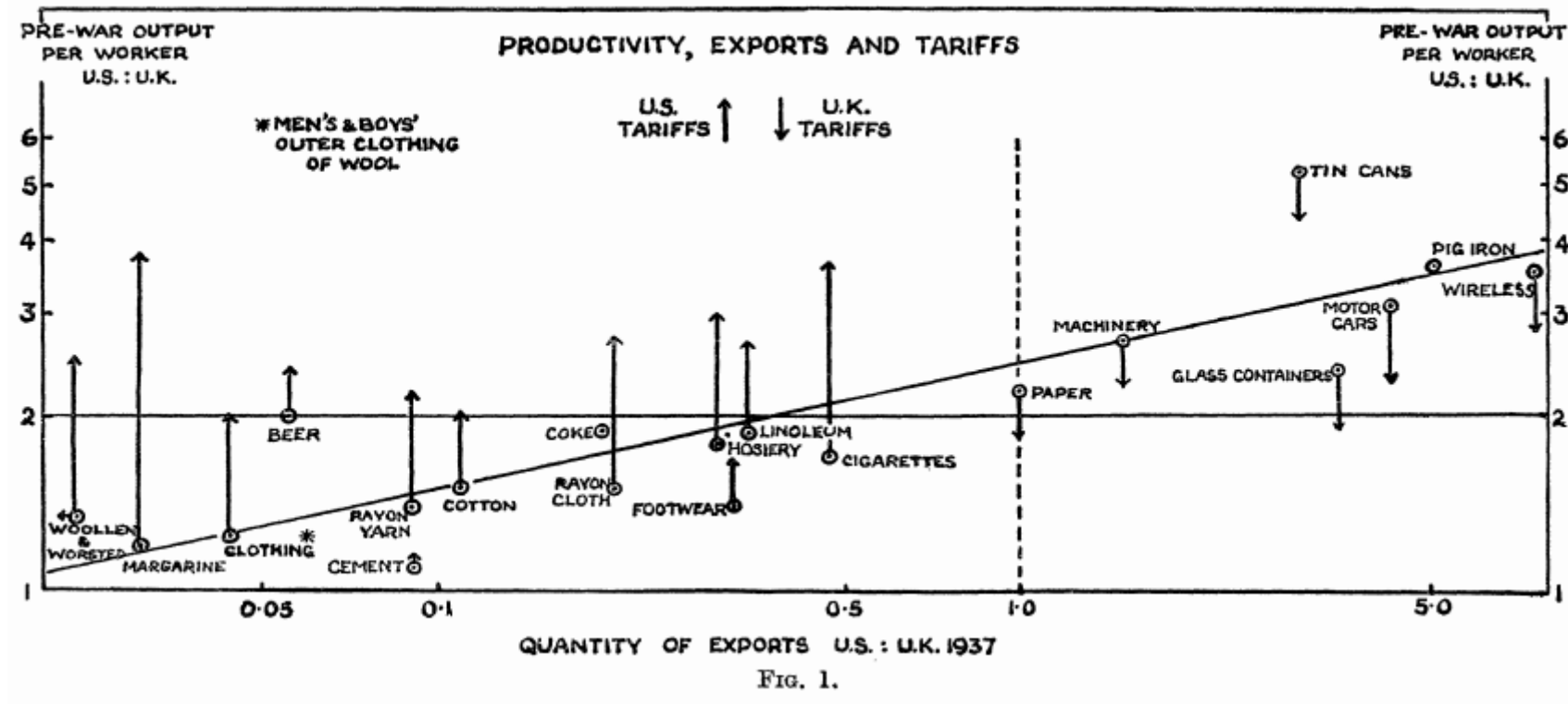
Trade – Equilibrium (contd.)
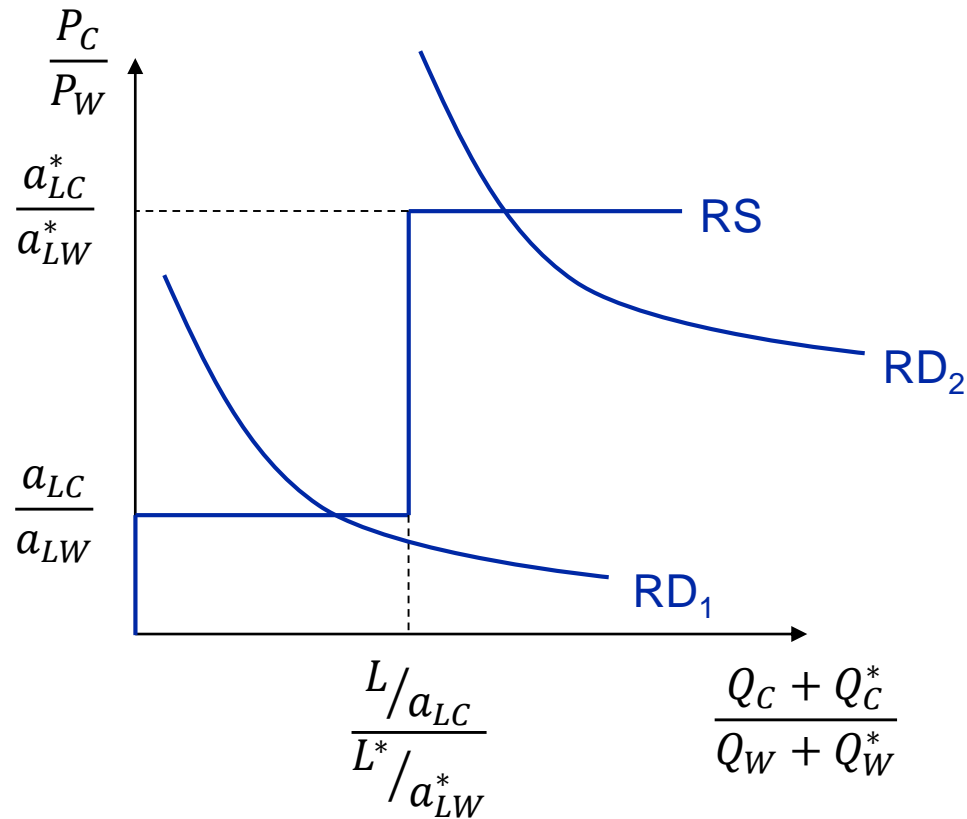
Clicker question:

In the case denoted by RD₁, the relative cheese price in Home is the same under autarky and trade. True or False?

Trade – Classic evidence on Ricardian comparative advantage

Source: McDougall (1951)

Trade – Modern evidence on Ricardian comparative advantage

- Because of the large taxonomy of possible cases, the Ricardian model is hard to generalize to more than two countries and industries

- This has only been achieved recently by Eaton and Kortum (2002) building on an earlier multi-industry extension by Dornbusch et al (1977)

- Costinot et al (2014) use the Eaton and Kortum (2002) model to provide the first theoretically consistent Ricardian test

- They find that the elasticity of bilateral exports with respect to observed productivity is positive, as the Ricardian model predicts, and equal to 6.53

Trade – The case of Japan's forced trade opening

- Instead of saying that countries export the goods in which they have a comparative advantage, we can also say that countries export the goods in which the have lower autarky relative prices

- An obvious problem with taking this prediction to the data is that we need to be able to observe autarky relative prices and trade relative prices at the same time

- In a fascinating study, Bernhofen and Brown (2004) consider Japan's forced trade opening between 1858-59 as a natural experiment

- Japan was virtually closed in 1858 thus providing a unique opportunity to compare autarky prices in 1858 to trade prices in 1859

Trade – The case of Japan's forced trade opening (contd.)

- Japan's policy of autarky began in 1639 when all contact between the Japanese and outsiders, including trade, were forbidden with few exceptions

- Japan was forced to open to trade under military pressure from the United States so that this trade liberalization can be thought of as a natural experiment

- Trade growth was rapid after opening up in 1858 with Japan's per-capita imports growing to three times the level of China's per-capita imports by 1873

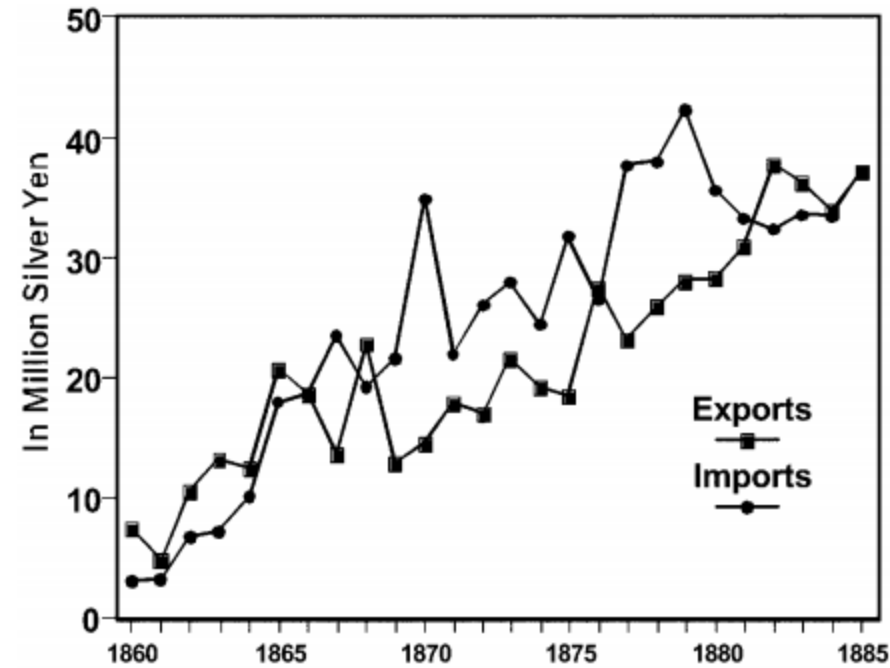# Trade – The case of Japan's forced trade opening (contd.)

FIG. 3.—The development of Japan's external trade, 1860–85. Source: Sugiyama (1988, table 3-4).

Source: Bernhofen and Brown (2004)

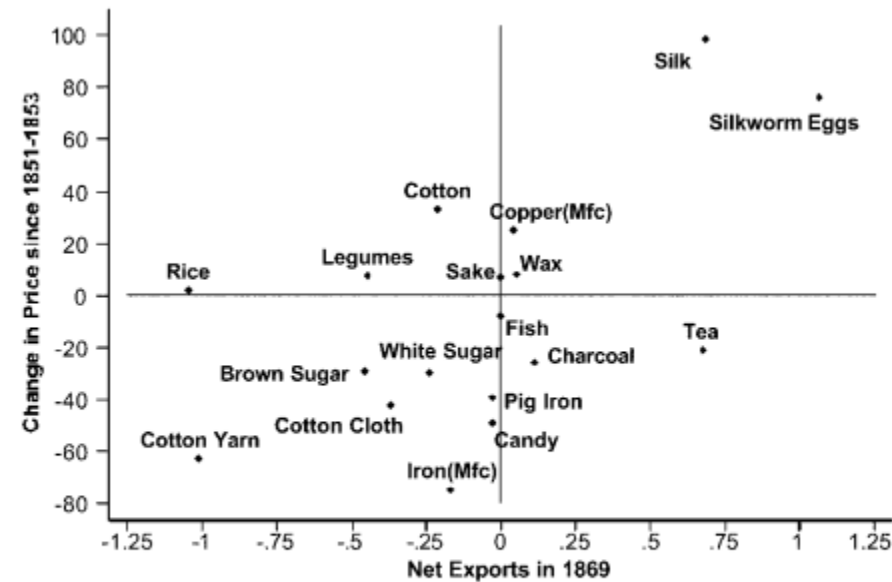# Trade – The case of Japan's forced trade opening (contd.)

FIG. 4.—Net exports and price changes for 1869. Source: Japan Bureau of Revenue (1893) for trade data and Kinyu Kenkyukai (1937), Miyamoto (1963), Ono (1979), Yamazaki (1983), and Mitsui Bunko (1989) for price data.

Source: Bernhofen and Brown (2004)

Trade – Relative wages

- So, it appears that countries indeed export the goods in which they have a comparative advantage, just like the Ricardian model predicts

- But what ensures that countries are competitive in world markets in their comparative advantage industries?

- The answer is that relative wages adjust to ensure that each country has a cost advantage in its comparative advantage industry

- Loosely speaking, wage differences neutralize absolute productivity differences so that only relative productivity differences matter for export success

Trade – Relative wages (contd.)

- From the RS/RD diagram, we see that

$$\frac{a_{LC}}{a_{LW}} \leq \frac{P_C}{P_W} \leq \frac{a_{LC}^*}{a_{LW}^*}$$

- Since Home makes cheese and Foreign makes wine we know that

$$P_C = a_{LC}w$$

$$P_W = a_{LW}^*w^*$$

- Together this implies that relative wages must satisfy

$$\frac{a_{LW}^*}{a_{LW}} \leq \frac{w}{w^*} \leq \frac{a_{LC}^*}{a_{LC}}$$

Trade – Relative wages (contd.)

- For example, if Home's cheese productivity was 4 times higher and Home's wine productivity was 3 times higher than Foreign's, then Home's wage would be between 3 and 4 times higher than Foreign's so that Home would have a cost advantage in cheese but not wine

- The economic force underlying this is labor market clearing. If Foreign had a cost advantage in all goods, nobody would buy Home's goods so that Home's wages would fall until Home's comparative advantage goods became competitive

- This is a fundamental way in which countries differ from corporations and why thinking about competition between nations often does not make much sense. Countries cannot go out of business while corporations can

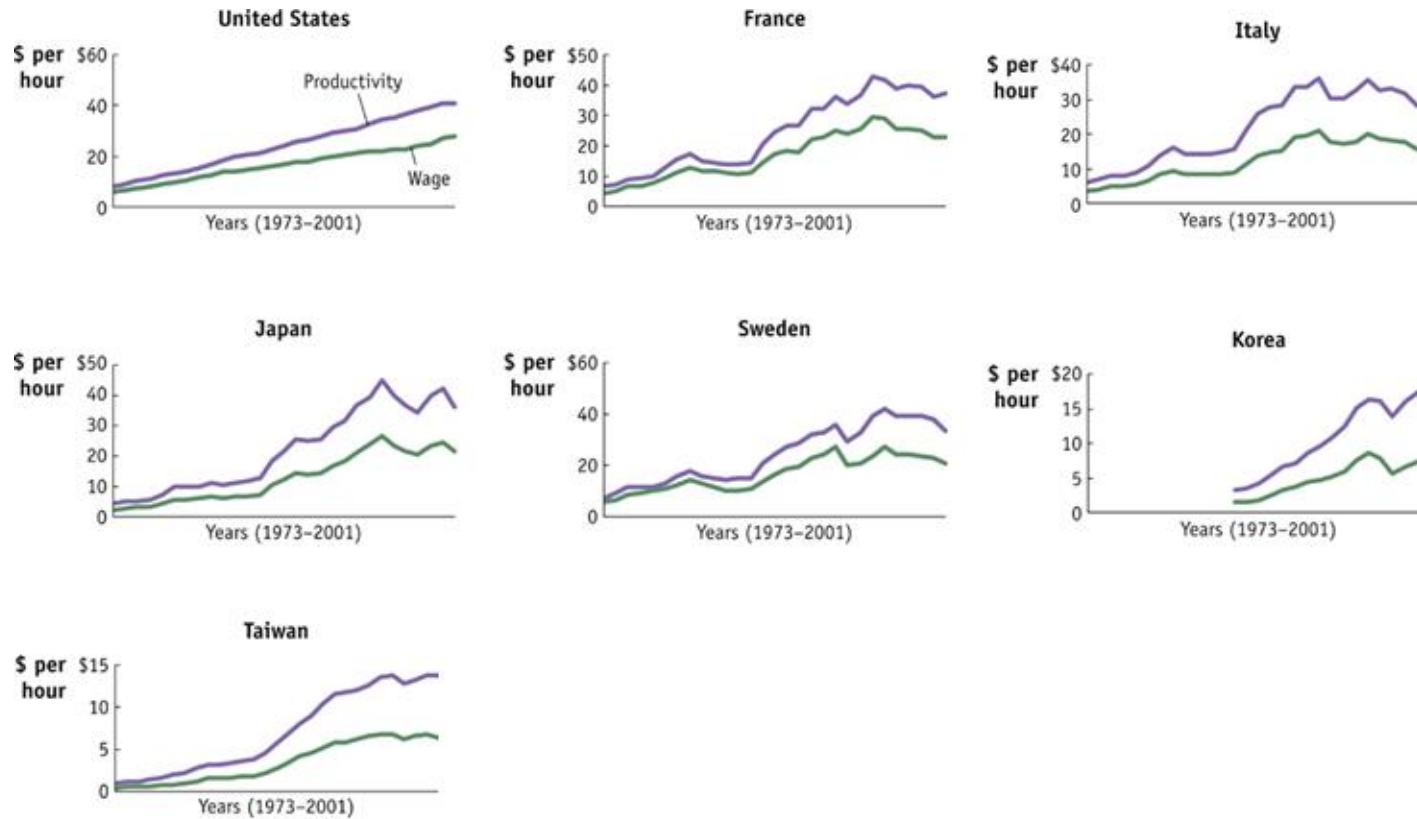# Trade – Evidence on productivity and wages

Labor Productivity and Wages, 2001
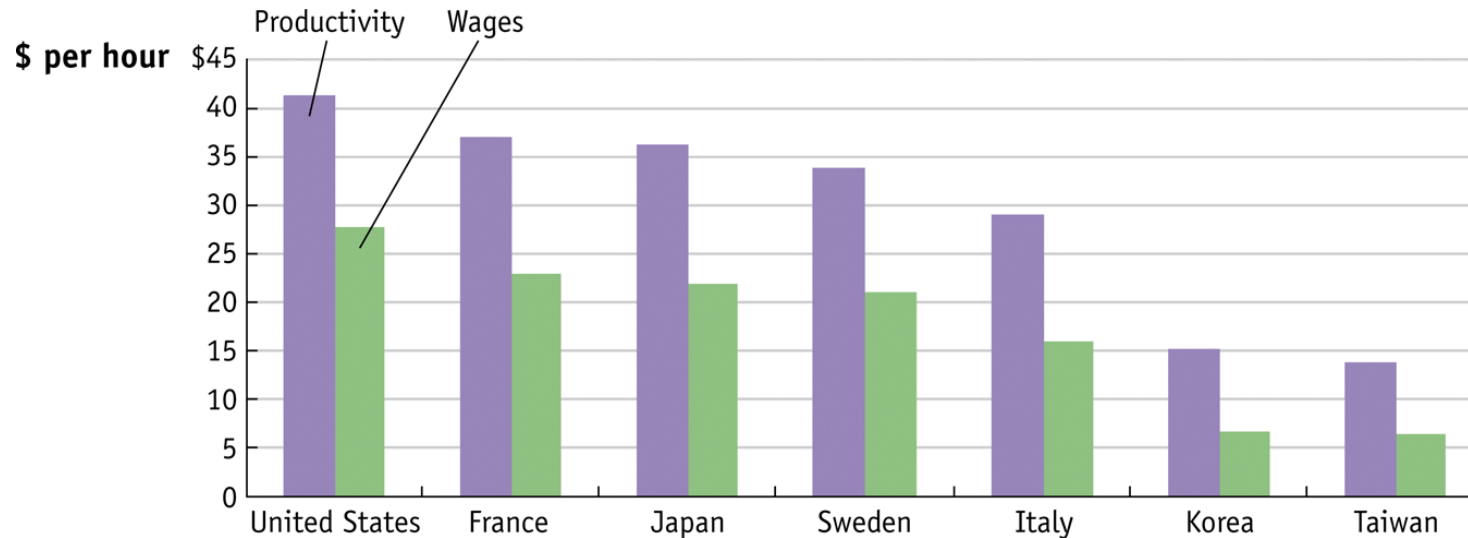
Note: Labor productivity is measured as value added per hour, where value added is defined as revenue minus the cost of intermediate inputs. You would get a similarly high correlation, if you used the wage and productivity data from the first slides
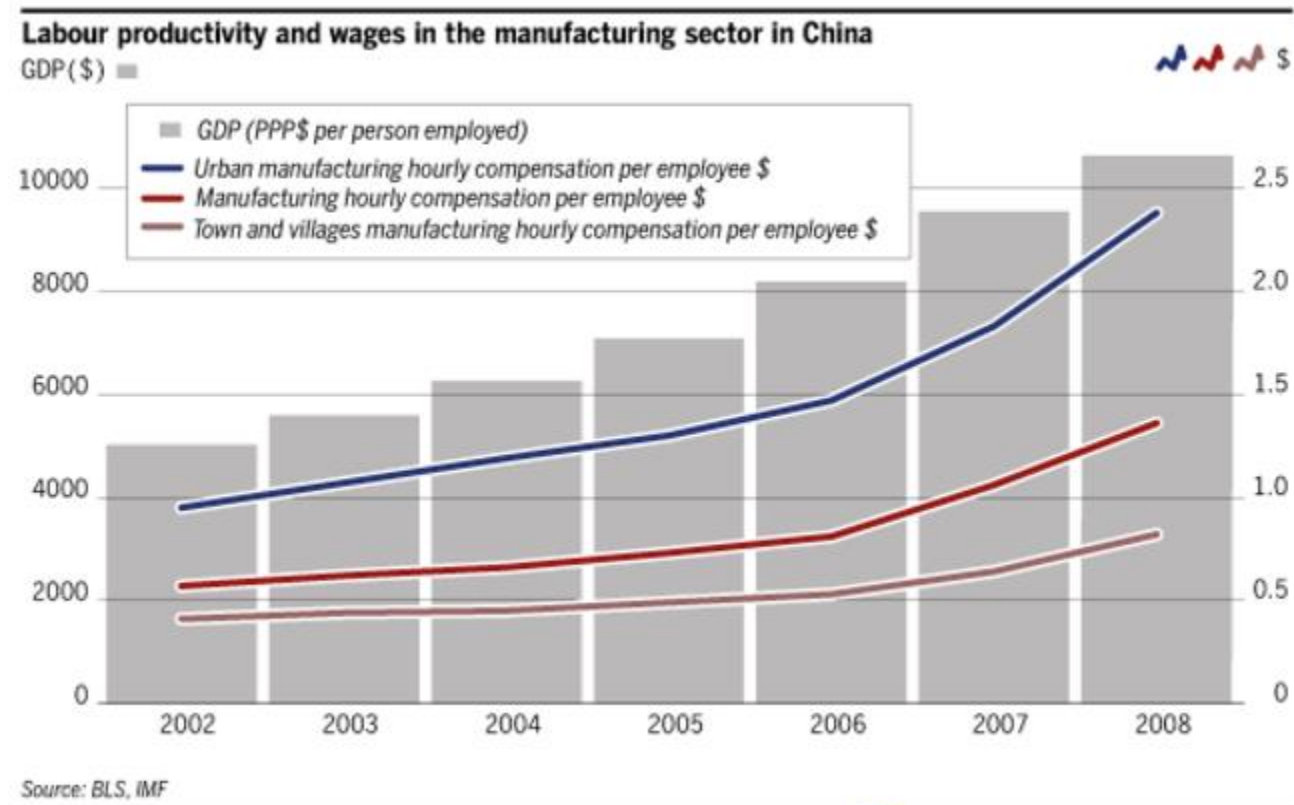
Source: Krugman et al (2014)

Trade – Evidence on productivity and wages (contd.)

Source: Krugman et al (2014)

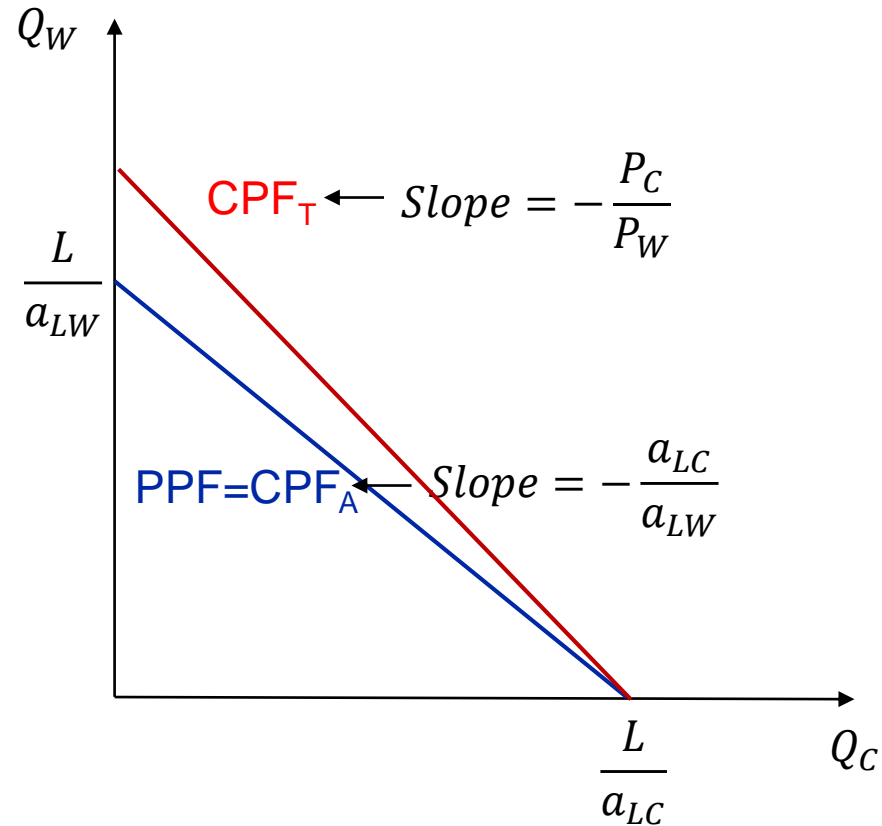# Trade – Evidence on productivity and wages (contd.)

Source: The Economist

Trade – Gains from trade

- Under autarky, consumption possibilities are constrained by production possibilities so that the consumption possibilities frontier is the same as the PPF

- The **consumption possibilities frontier** (CPF) characterizes the maximum amount of cheese and wine the economy can consume given its available technology and resources

- Under trade, Home's budget is given by the value of its cheese production in world markets so that the CPF is implicitly defined by $P_C \frac{L}{a_{LC}} = P_C Q_C + P_W Q_W$ which implies

$$Q_W = \frac{P_C}{P_W} \frac{L}{a_{LC}} - \frac{P_C}{P_W} Q_C$$

Trade – Gains from trade (contd.)

Q_W

CPF_T ← $Slope = -\dfrac{P_C}{P_W}$

$\dfrac{L}{a_{LW}}$

$PPF{=}CPF_A$ ← $Slope = -\dfrac{a_{LC}}{a_{LW}}$

$\dfrac{L}{a_{LC}}$ Q_C

Clicker question:

Home only gains from trade if one of its industries disappears entirely. True of False?

Trade – Gains from trade

-   Hence, trade increases Home's consumption possibilities whenever $\frac{P_C}{P_W} > \frac{a_{LC}}{a_{LW}}$ which is true unless the RD curve intersects the RS curve in its lower horizontal portion in which case Home's consumption possibilities remain unchanged

-   Analogously, trade increases Foreign's consumption possibilities whenever $\frac{P_C}{P_W} < \frac{a_{LC}}{a_{LW}}$ which is true unless the RD curve intersects the RS curve in its upper horizontal portion in which case Foreign's consumption possibilities remain unchanged

-   This is the second main result of the Ricardian model: countries usually gain and never lose from trade. The basic intuition is that trade is like a technology which transforms the export good into the import good at a lower opportunity cost than the domestic technology

-   This is again not at all obvious since it implies that (i) high wage countries can gain from trade with low wage countries, (ii) low productivity countries can gain from trade with high productivity countries, and (iii) countries can gain from trade even if they lose entire industries

Conclusion

-   We discussed the Ricardian trade model which explains how relative labor costs and relative labor productivity interact to determine the pattern of trade

-   It delivers two main results: (i) the pattern of trade is determined by comparative and not absolute advantage, and (ii) countries usually gain and never lose from trade

-   This model alone can clarify many common misconceptions about trade. Perhaps most importantly, countries do not compete in world markets like corporations so that trade is not a zero-sum game

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