Lecture 2: Comparative Advantage and the Ricardian Trade Model

Econ 355 - Introduction to International Trade

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Why Do Countries Trade?

The main reasons why countries trade:

- *Differences* across countries in:
  - **Technologies** (ability to produce goods)
  - **Resources** (labor, capital, land and natural resources)
  - Costs of **offshoring** (splitting the production of a good in several locations)
- **Proximity**: despite progress in reducing transport costs, countries that are close to each other still trade a lot more than countries that are far away
- **Increasing returns to scale:** it makes sense for countries to specialize and trade

Ricardian Model

- Today we will focus on technology differences across countries as an explanation for trade
- Technology differences are the basis of the **Ricardian** model of trade
- What is **technology**?
  - In this course and in most of your econ classes technology will be represented by a production function: how much output you can get given a certain amount of inputs (e.g. labor)
- Why does technology differ across countries?
  - Patents/intellectual property rights prevent imitation
  - In some countries you cannot apply the same technology as in others (because of limited knowledge by workers, lack of necessary inputs, different environment, etc.)

Absolute Advantage and Comparative Advantage

- We will need two fundamental concepts to talk about technology differences across countries as a reason for trade
  - **Absolute advantage**
  - **Comparative advantage**
- We will explain comparative advantage using the concept of an **opportunity cost**

Absolute Advantage and Comparative Advantage

- Example: David and Omar work at Blue Chip
- For each extra hour of work the marginal product of labor is as follows (please write these numbers down)
- Omar can produce:
  - **either** 60 cookies
  - **or** 40 espressos
- David can produce:
  - **either** 20 cookies
  - **or** 10 espressos

Participation Question

What would be the optimal allocation of tasks across Omar and David assuming that making cookies and espressos is all they can do and that both goods need to be produced?
A) Both David and Omar should spend half the time making cookies and the other half making espressos
B) Omar should do everything
C) David should only make espressos and Omar should only make cookies
D) Omar should make some espressos and David should make some cookies

Opportunity Cost

- We can answer the previous question using the concept of **opportunity cost**
- Opportunity cost: the cost of producing a good in terms of its best alternative use
- The **opportunity cost** of producing a cookie for Omar is not producing 2/3 of an espresso
- The **opportunity cost** of producing a cookie for David is not producing 1/2 an espresso
- It is optimal for each good to be produced by the person with the lowest opportunity cost of making that good:
  - Omar should make some espressos and David should make some cookies

Absolute Advantage, Comparative Advantage and Opportunity Cost

- We say that Omar has an **absolute advantage** in making both espresso and cookies because he is more productive in both
- Omar has a **comparative advantage** in making espressos because he has a lower opportunity costs of espressos (1.5 cookies) than David (2 cookies)
  - Omar is relatively more productive in espressos than cookies
- David has a **comparative advantage** in making cookies because he has a lower opportunity costs of cookies (1/2 espresso) than Omar (2/3 espresso)
  - David is relatively more productive in cookies than espressos

Why Is the Model Called Ricardian?

England exported cloth in exchange for wine, because, by so doing her industry was rendered more productive to her; she had more cloth and wine than if she had manufactured both for herself; and Portugal imported cloth and exported wine, because the industry of Portugal could be more beneficially employed for both countries in producing wine... It would therefore be advantageous for [Portugal] to export wine in exchange for cloth. This exchange might even take place, notwithstanding that the commodity imported by Portugal could be produced there with less labour than in England.

– David Ricardo, *On the Principles of Political Economy and Taxation*, 1821

Setup of the Ricardian Model

- 2 countries: Home country and Foreign country
  - Denote Foreign variables with an asterisk *
- 2 goods: wheat and cloth
  - Q_C quantity of cloth produced in Home
  - Q_W quantity of wheat produced in Home
- 1 factor of production: labor ($\overline{L}$ and $\overline{L}^*$ respectively in Home and Foreign)
- Constant marginal product of labor (MPL) - the extra output produced with one additional unit of labor

PPF in Home Country

- $\overline{L} = 25$
- $MPL_W = 4$
- $MPL_C = 2$
- If Home country employs **all** workers in wheat it will produce:

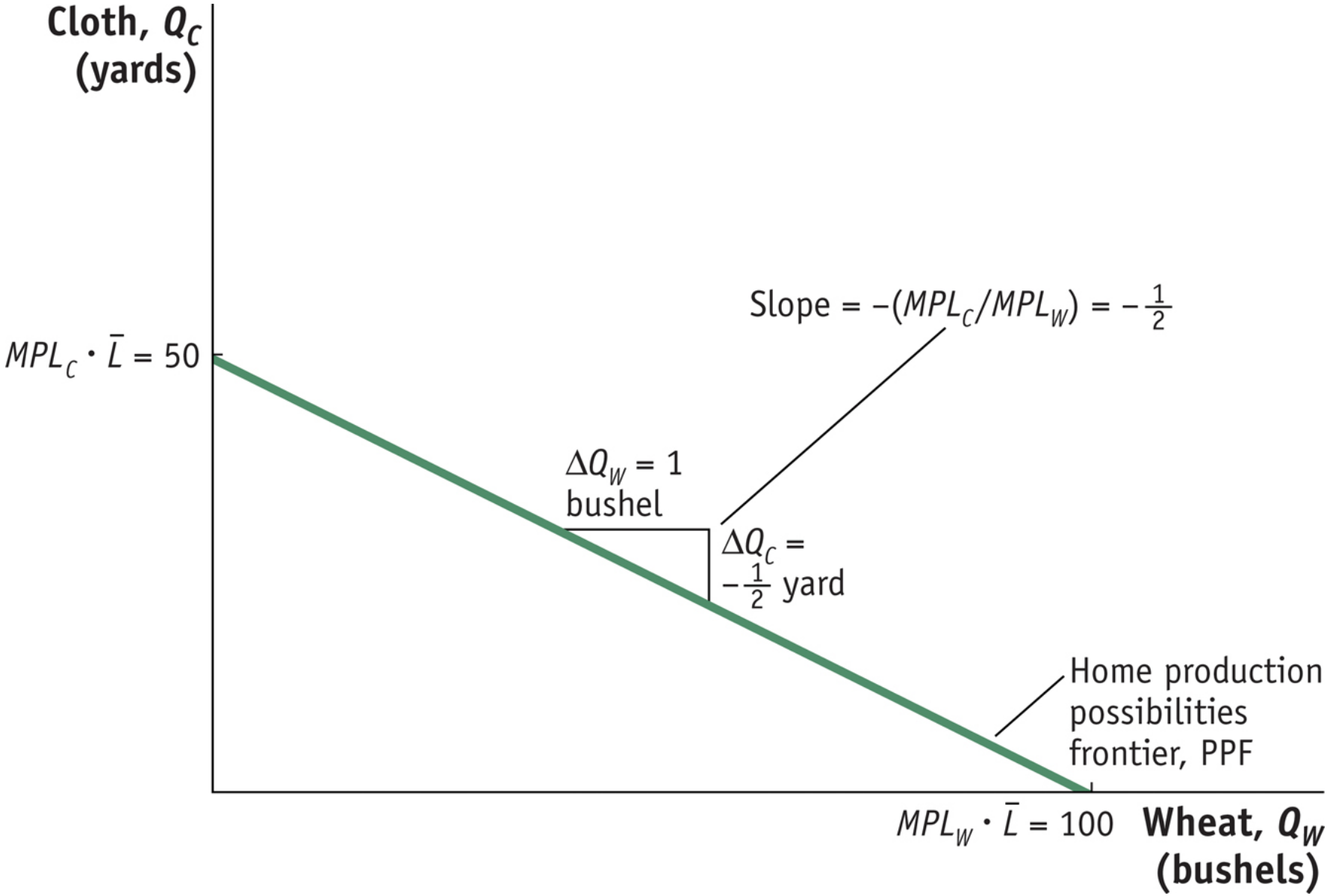
$$Q_W = MPL_W \times \overline{L} = 4 \times 25 = 100 \text{ bushels}$$

- If Home country employs **all** workers in cloth, it will produce:

$$Q_C = MPL_C \times \overline{L} = 2 \times 25 = 50 \text{ yards}$$

- The **Production Possibility Frontier** (**PPF**) represents the maximum amount of cloth a country can produce, given a certain amount of wheat
- It is a straight line connecting the two points above

PPF in Home Country



PPF and Opportunity Cost

- Slope of the PPF measures the opportunity cost of wheat (measured in yards of cloth): how many yards of cloth does the country need to give up to obtain one more bushel of wheat?
- One more unit of wheat requires $1/4$ units of labor
- With $1/4$ unit of labor Home could have produced $1/4 \times 2 = 1/2$ yards of cloth
- So the opportunity cost of a bushel of wheat is $1/2$ yard of cloth or more generally:

$$\text{Slope of the PPF} = \frac{\Delta Q_C}{\Delta Q_W} = -\frac{MPL_C}{MPL_W}$$

Participation Question

Based on the definition of PPF that we just gave, what happens to the PPF if a better technology is developed that makes the $MPL_W = 8$ (instead of 4)?

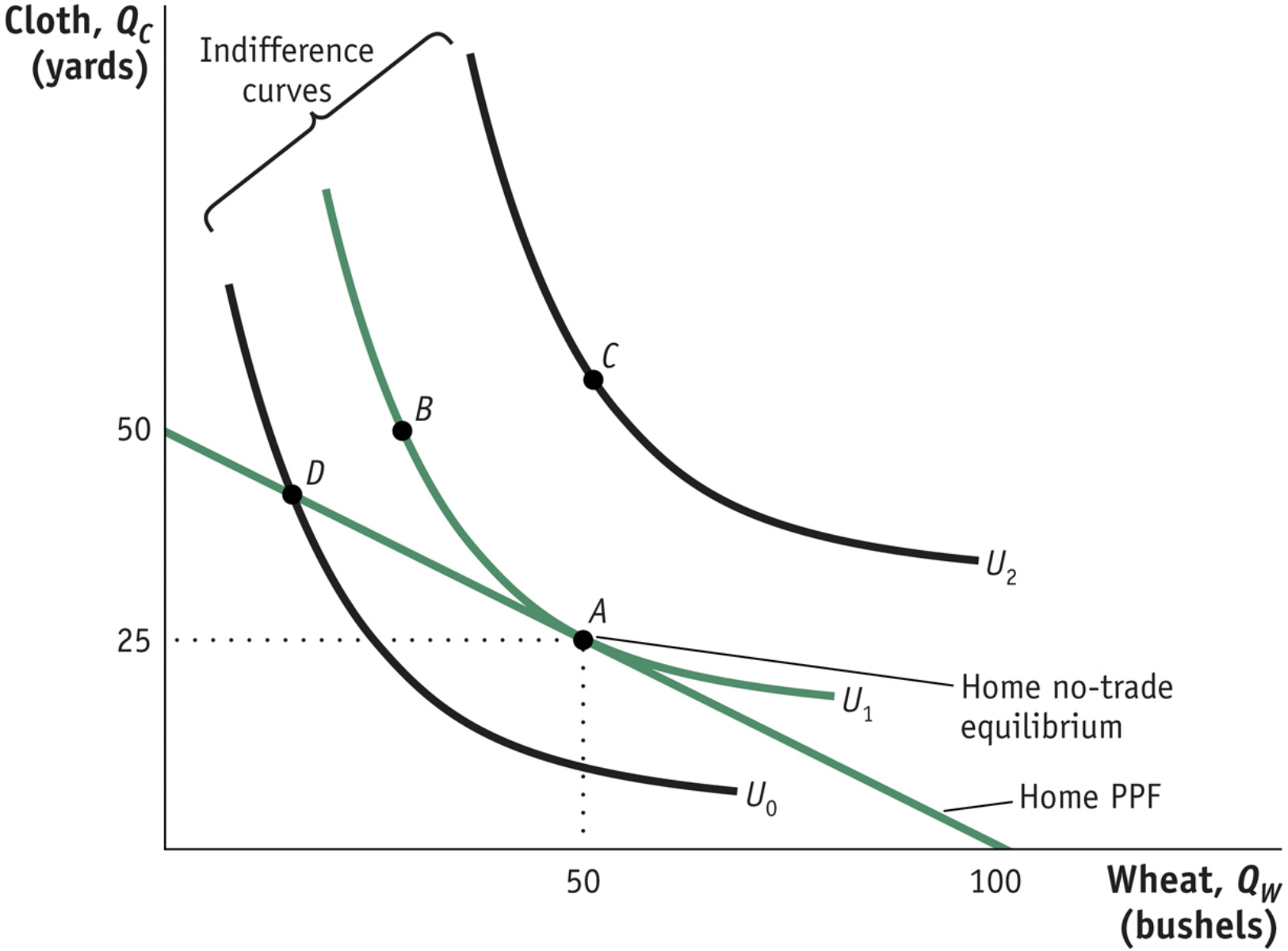
A) The PPF shifts out in a parallel manner
B) The PPF stays unchanged
C) The opportunity cost of wheat in terms of cloth increases to 4
D) The opportunity cost of wheat in terms of cloth declines to $1/4$
E) The PPF rotates around the initial consumption point

Autarky Equilibrium in Home

- Autarky = no international trade
- Now that we know the production possibilities of the country, how do we determine what the country will actually produce?

- What do we need to know?
- Preferences/demand for goods, which are represented by indifference curves
- **Indifference curves** represent the combination of goods along which **utility** (i.e. satisfaction, happiness) is constant
- Here PPF behaves like a budget constraint for the country
- The country will produce a combination of wheat and cloth such that it can reach the highest indifference curve possible
- Point A lies on the highest indifference curve the country can reach subject to the PPF constraint

Autarky Equilibrium in Home



Autarky Prices

- What is the **relative price** of wheat $\frac{P_W}{P_C}$ in Home in autarky?
  - We are often not going to care about nominal prices but only about relative prices
  - E.g., if $P_W = \$3$ per bushel and $P_C = \$6$ per yard then the relative price of wheat to cloth is:

$$\frac{P_W}{P_C} = \frac{3}{6} = \frac{1}{2}$$

- In this and other models at the beginning of the course we will assume perfect competition
- **Perfect competition**:
  - many small firms and many workers
  - take prices and wages as given (no market power)

Autarky Prices

- Under perfect competition workers in each industry are paid wage equal to the value of the marginal product of their labor:

$$\begin{aligned} W_C &= P_C MPL_C \\ W_W &= P_W MPL_W \end{aligned}$$

- The wage has to be the same across sectors since workers can move from Wheat to Cloth, i.e. $W_C = W_W$
- Rearranging terms we find:

$$\frac{P_W}{P_C} = \frac{MPL_C}{MPL_W} = \frac{1}{2}$$

- Relative price of wheat is equal to the opportunity cost of wheat

Foreign Country

- Foreign has overall worse technology than Home
- Home has absolute advantage in all goods
- Wheat: $MPL^*_W = 1$ and $MPL^*_C = 1$
- Labor $\overline{L}^* = 100$

Participation Question

The production possibilities frontier in Foreign:
A) Has slope -1
B) Is such that Foreign has a comparative advantage in cloth production
C) Is such that Foreign has a comparative advantage in wheat production
D) A and B
E) A and C

Autarky Equilibrium in Foreign

- The equilibrium is found in the same way as for Home
- Autarky relative price of wheat in Foreign is:

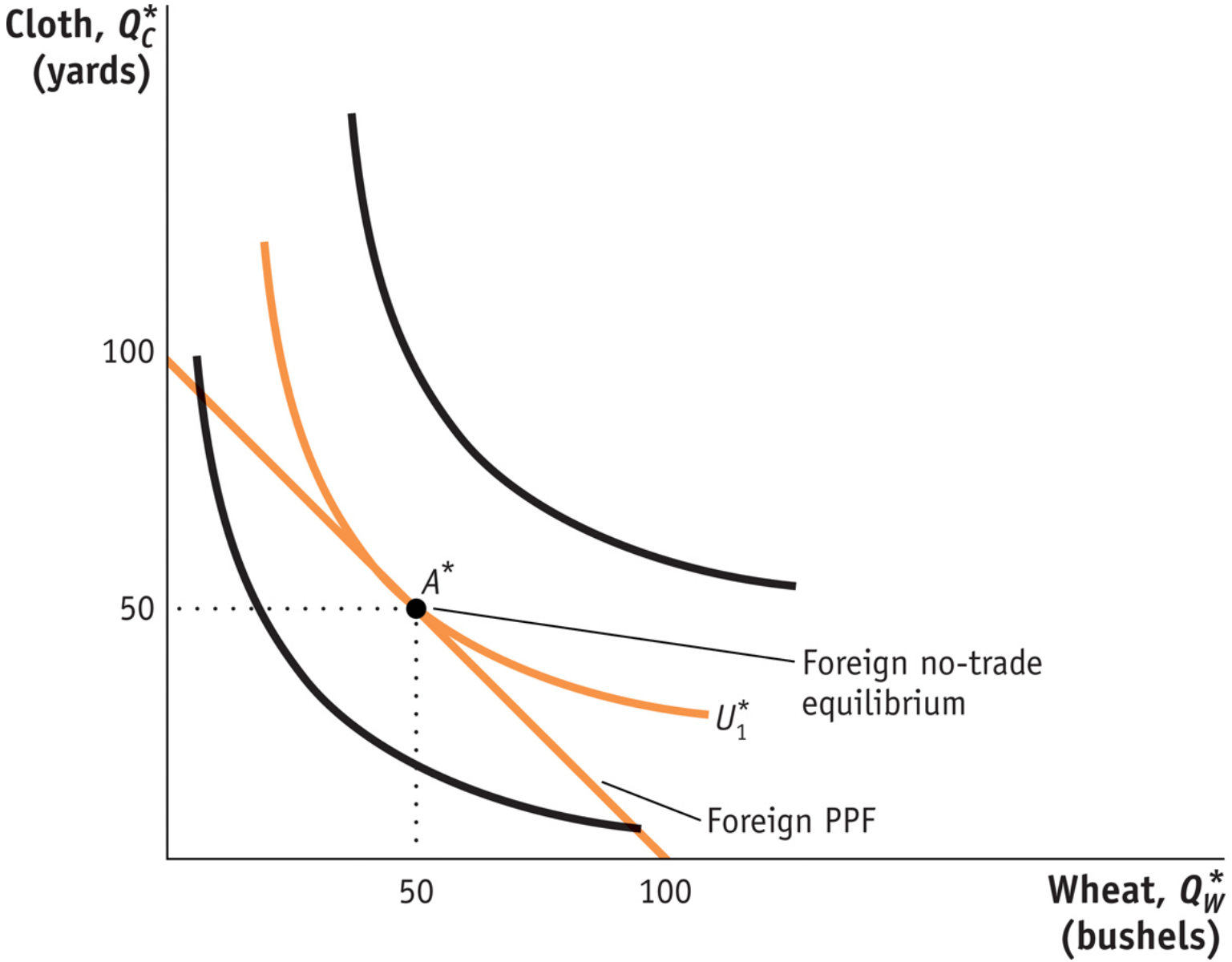
$$\frac{P_W^*}{P_C^*} = \frac{MPL_C^*}{MPL_W^*} = 1$$

- Notice that relative price of wheat is lower in Home under no international trade

$$\frac{P_W}{P_C} < \frac{P_W^*}{P_C^*}$$

- Home has a **comparative advantage** in wheat production

Autarky Equilibrium in Foreign



Wheat and Textiles in US and China

	United States	China	Absolute Advantage
	Sales/Employee	*Sales/Employee*	*U.S./China Ratio*
Apparel	$92,000	$13,500	7
Textiles	$140,000	$9,000	16
	Bushels/Hour	*Bushels/Hour*	*U.S./China Ratio*
Wheat	27.5	0.1	275
	Comparative Advantage		
Wheat/apparel ratio × 1,000	0.3	0.01	
Wheat/textile ratio × 1,000	0.2	0.01	

- US has absolute advantage in all goods and comparative advantage in wheat
- US exports wheat while China exports textiles and apparel

International Trade Equilibrium

- What happens if we allow the two countries to exchange goods?
- Country's no-trade relative price will determine which good it will export and which it will import
- Recall that the no-trade relative price is equal to the opportunity cost of production
- Pattern of exports and imports will be determined by comparing the opportunity cost of production across countries
  - Pattern of trade will be determined by comparative advantage

International Trade Equilibrium

- Remember that in no-trade equilibrium:

$$\frac{1}{2} = \frac{P_W}{P_C} < \frac{P_W^*}{P_C^*} = 1$$

- Wheat producer in Home would prefer to sell in Foreign market and get 1 yard of cloth instead of 1/2
- Cloth producers in Foreign would prefer to sell in Home and get 2 bushels of wheat instead of 1
- Two countries are in **international trade equilibrium** when the relative price of cloth is the same in both countries

- Key questions:
  - What will be the relative price of wheat in the trade equilibrium?
  - What do the two countries export?
  - How do production and consumption change in the trade equilibrium?

International Trade Equilibrium

- Common international trade price $\left(\frac{P_W}{P_C}\right)_T$ in trade equilibrium will be between the no-trade prices in the two countries:

$$\frac{P_W}{P_C} \leq \left(\frac{P_W}{P_C}\right)_T \leq \frac{P_W^*}{P_C^*}$$

- Home exports wheat, Foreign exports cloth until relative prices are equalized in the two countries
- Each country exports good in which it has comparative advantage
- Later we will see how $\left(\frac{P_W}{P_C}\right)_T$ is determined

Home in Trade Equilibrium

- Assume for example that

$$\left(\frac{P_W}{P_C}\right)_T = \frac{2}{3}$$

- This international trade relative price of wheat is higher than its opportunity cost in Home
- Home will produce more wheat and less cloth
- How much more?
  - Guess: the maximum amount it can produce: $Q_W = 100$
- Let's verify that all workers want to work in wheat
  - If work in cloth wage is equal to $VMPL_C = P_C \times MPL_C$
  - If work in wheat wage is equal to $VMPL_W = P_W \times MPL_W$

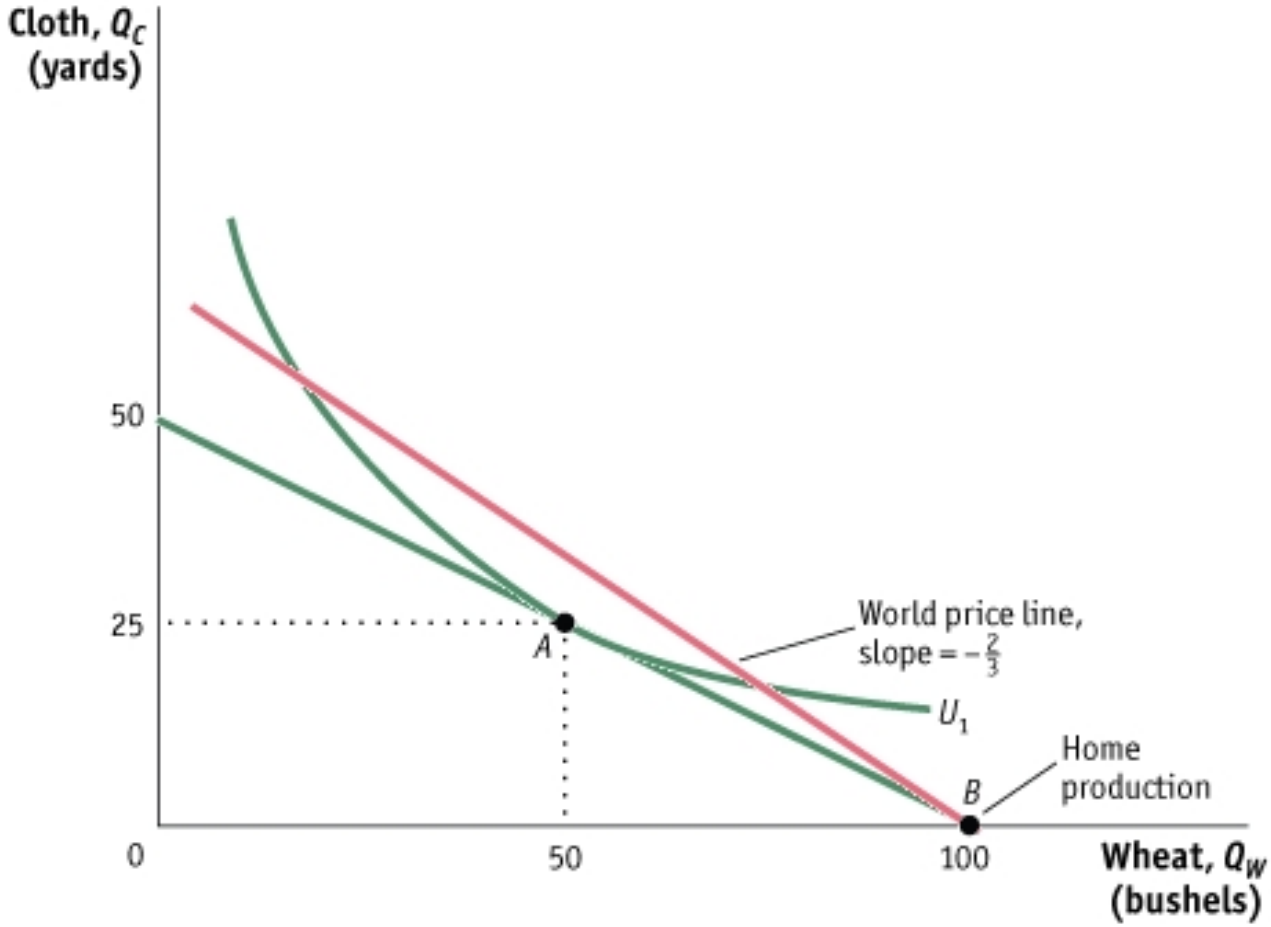
Home in Trade Equilibrium

- Wages are higher in wheat

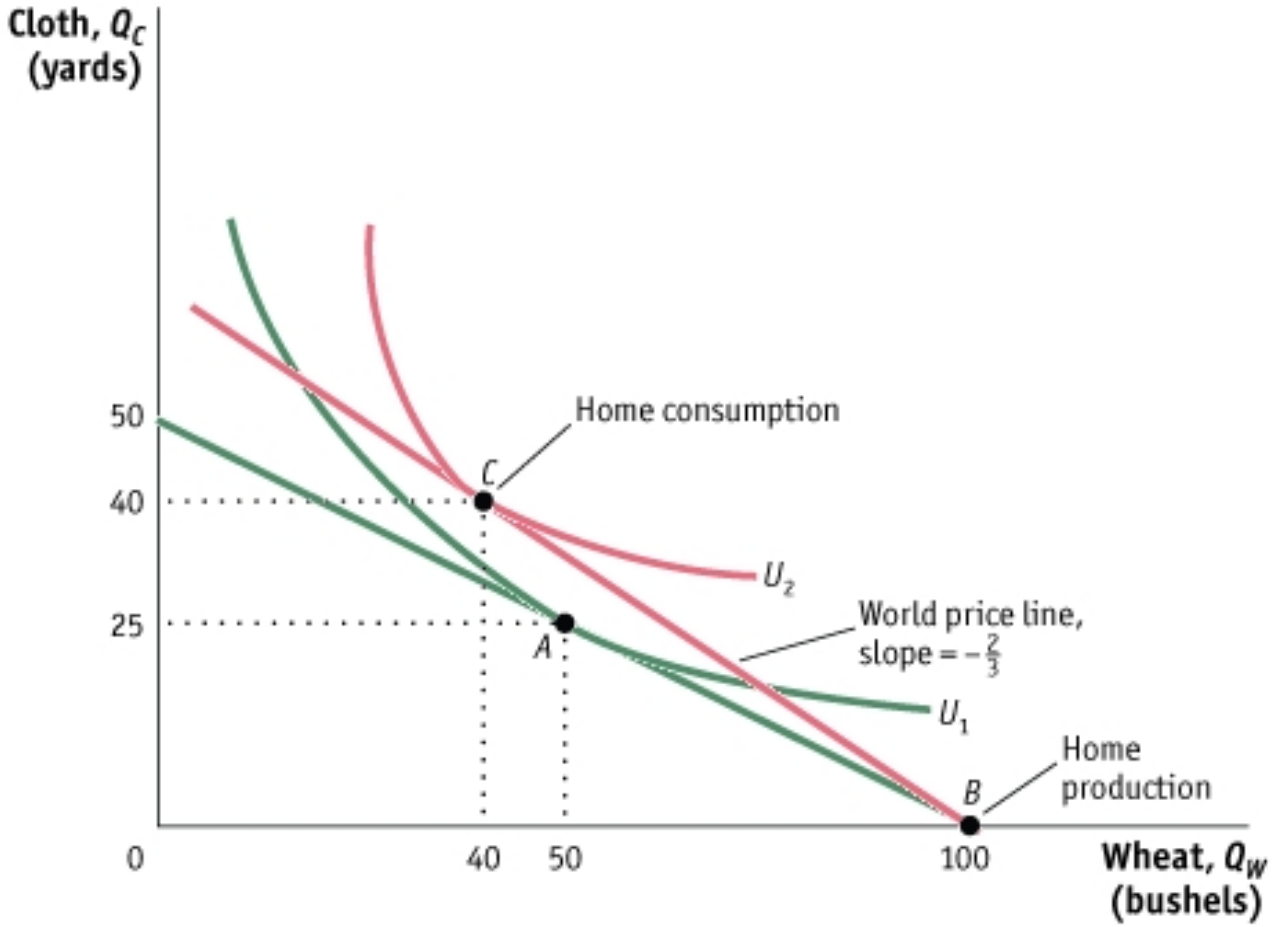
$$\frac{P_W \times MPL_W}{P_C \times MPL_C} = \frac{2}{3} \times \frac{4}{2} = \frac{4}{3} > 1$$

- Therefore all workers work in wheat
- Home:
  - **completely specializes** in wheat production (point B)
  - Home **exports wheat** and **imports cloth** from Foreign
  - Home obtains $\frac{2}{3}$ yards of cloth for each bushel of wheat exported (red line)

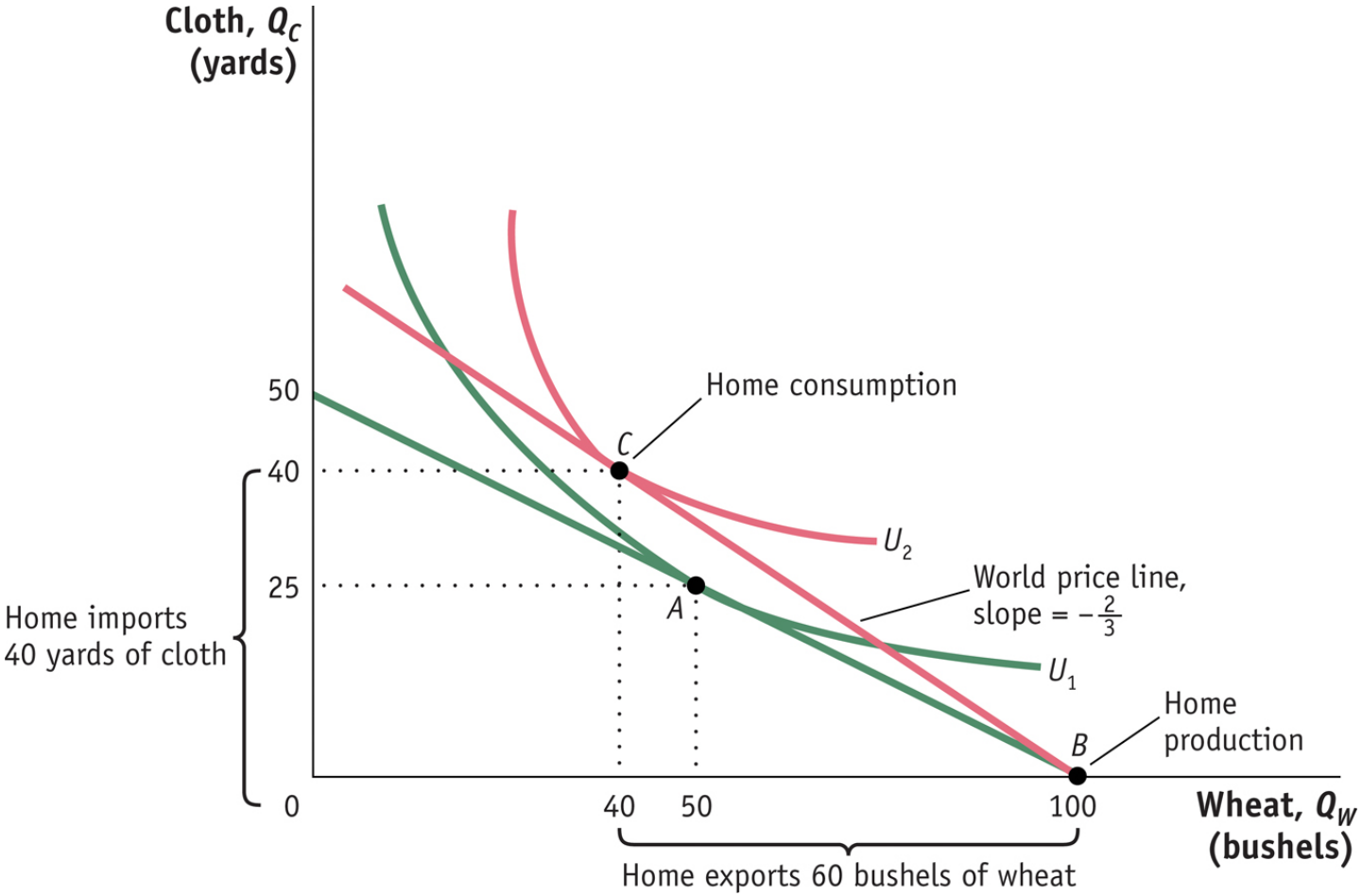
Production in Home



Consumption in Home



Exports and Imports in Home



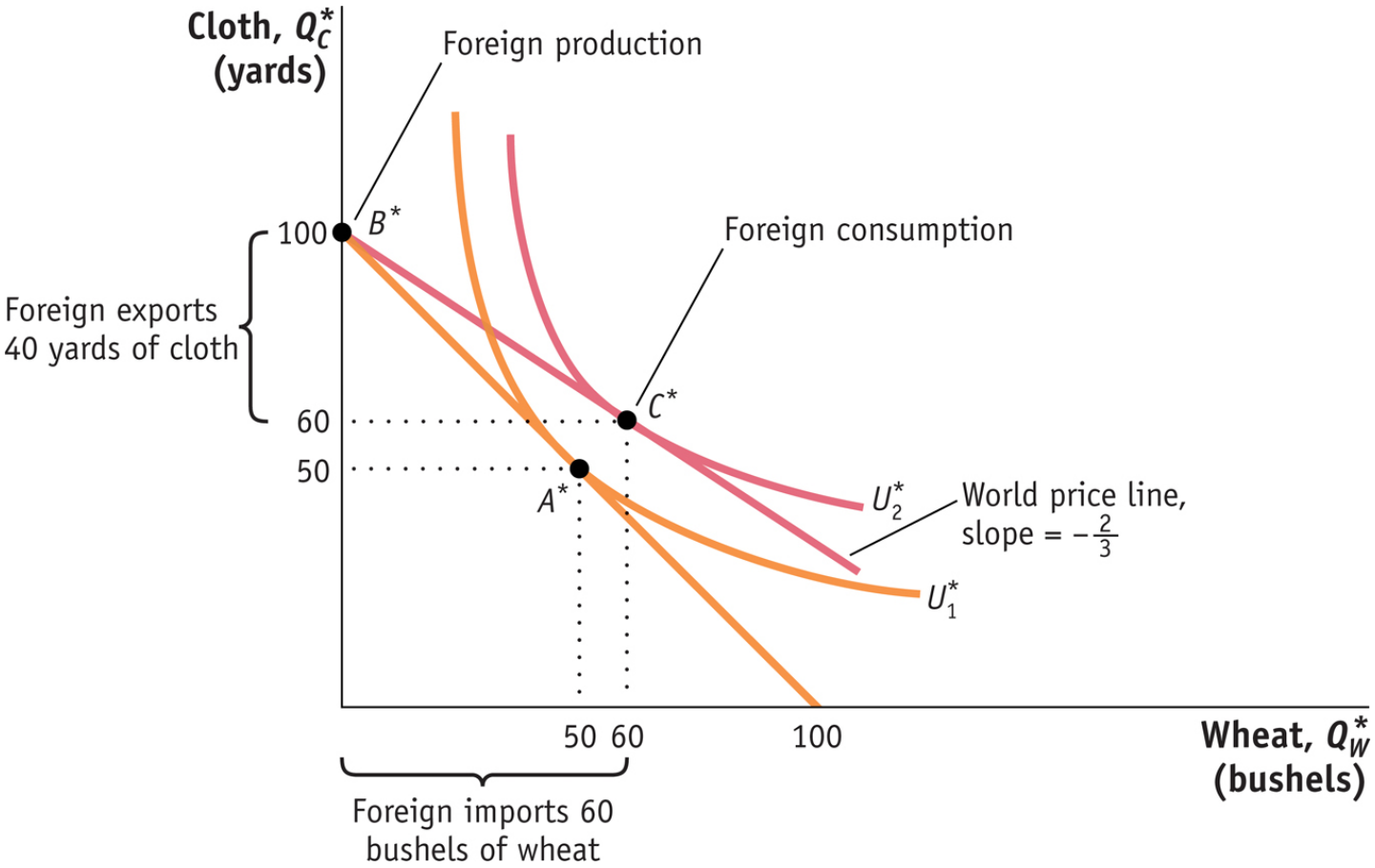
Gains from Trade

- Under autarky Home can only consume along PPF (Consumption Possibilities Frontier=PPF)
- Under trade, consumption possibilities expand and the country can consume more
  - Consumption Possibilities Frontier (red line or World Price Line in the book) is above the PPF
  - as if the country's budget constraint had expanded
- Utility at point C is higher than at point A (U_2 is above U_1)
- This shows that there are **gains from trade**: Home is better off under international trade than under autarky

Participation Question

What happens in Foreign as the country opens up to trade with Home?
A) Consumption Possibilities Frontier expands in terms of wheat, but contract in terms of cloth
B) The relative price of wheat declines compared to autarky
C) Foreign consumes more cloth and less wheat than in autarky
D) Foreign produces a bit of wheat but much more cloth than under autarky
E) All of the above

Foreign in Trade Equilibrium



Ricardian Model: Taking Stock

- Two main insights from the Ricardian model we have learned so far:
  - Each country exports the good in which it has comparative advantage
  - Each country gains from trade
- Two more questions we want to answer:
  - How are wages across countries determined?
  - How is the international trade price determined?

Real Wages in Trade Equilibrium

- Workers are paid their marginal product
- We can measure real wages in terms of cloth or wheat

- In Home: workers only work in wheat
  - Real wages measured in wheat:

$$MPL_W = 4 \text{ bushels of wheat}$$

  - **OR** Real wages measured in cloth:

$$4 \times \left(\frac{P_W}{P_C}\right)_T = 4 \times \frac{2}{3} = \frac{8}{3} \text{ yards of cloth}$$

Real Wages in Trade Equilibrium

- In Foreign: workers only work in cloth
  - Real wages measured in cloth:

$$MPL_C^* = 1 \text{ yards of cloth}$$

  - Real wages measured in wheat:

$$1 \times \left(\frac{P_C}{P_W}\right)_T = 1 \times \frac{3}{2} = \frac{3}{2} \text{ bushels of wheat}$$

Participation Question

Compared to the real wage in autarky, the real wage in the trade equilibrium in Home:
A) Increased in terms of both wheat and cloth
B) Increased in terms of wheat but decreased in terms of cloth
C) Increased in terms of cloth but decreased in terms of wheat
D) Stayed the same in terms of both wheat and cloth
E) Stayed the same in terms of wheat but increased in terms of cloth

- Real wages increase or at least stay the same in terms of both goods, in both countries
- Another way of seeing that there are gains from trade

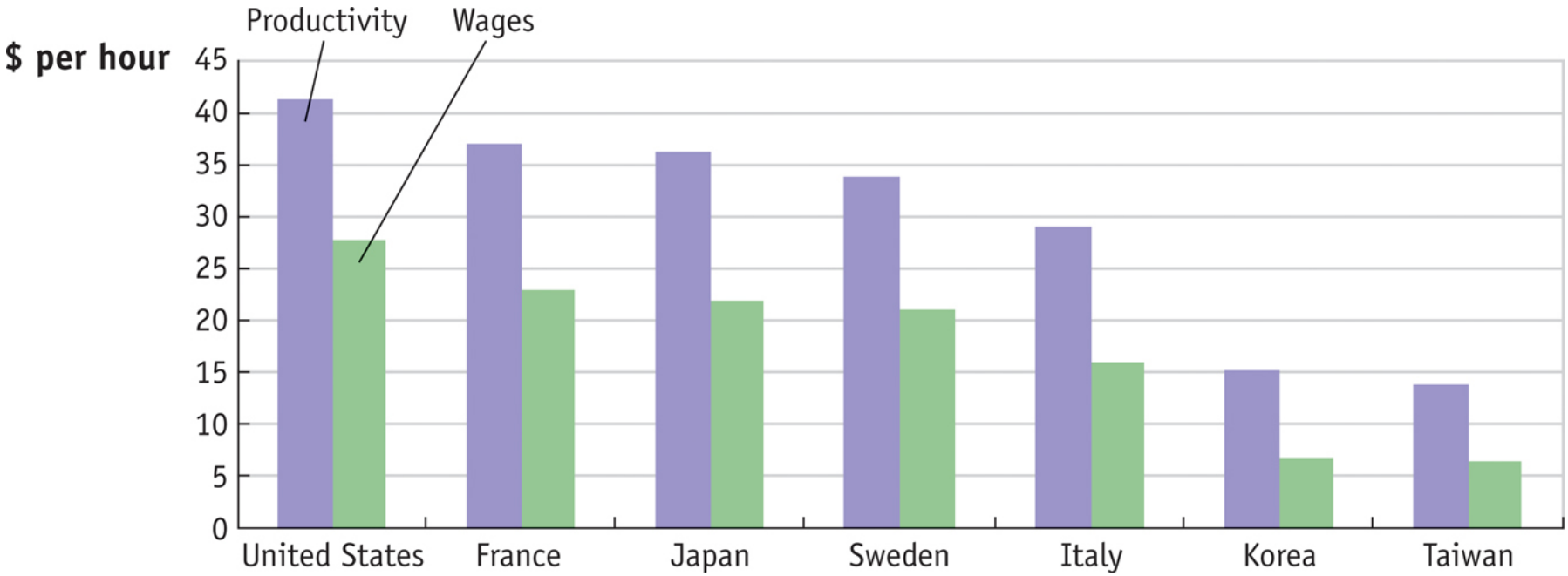
Absolute Advantage and Wages

- Home has an absolute advantage in both goods and also higher real wage, whether measured in terms of wheat or cloth
- Absolute advantage determines real wages and therefore consumption
- Comparative advantage determines the pattern of trade (i.e. what countries export)

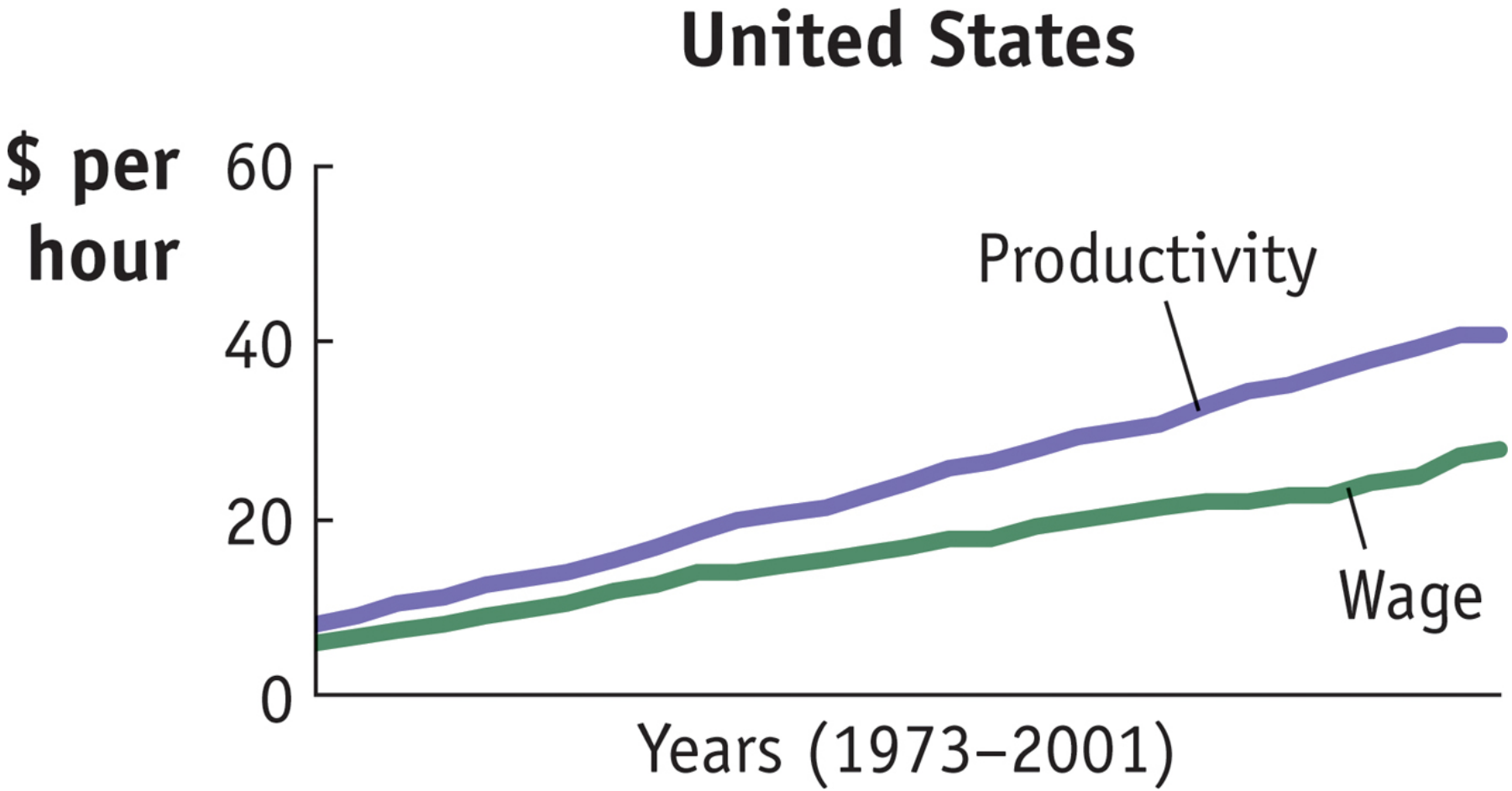
Labor Productivity and Wages

- How can we measure productivity in the data?
- One straightforward method: **value added per worker**
- Value added = value of output - value of intermediate goods and materials used in production
- In the data we observe a positive relationship between measured productivity and wages

Labor Productivity and Wages: Cross-Section



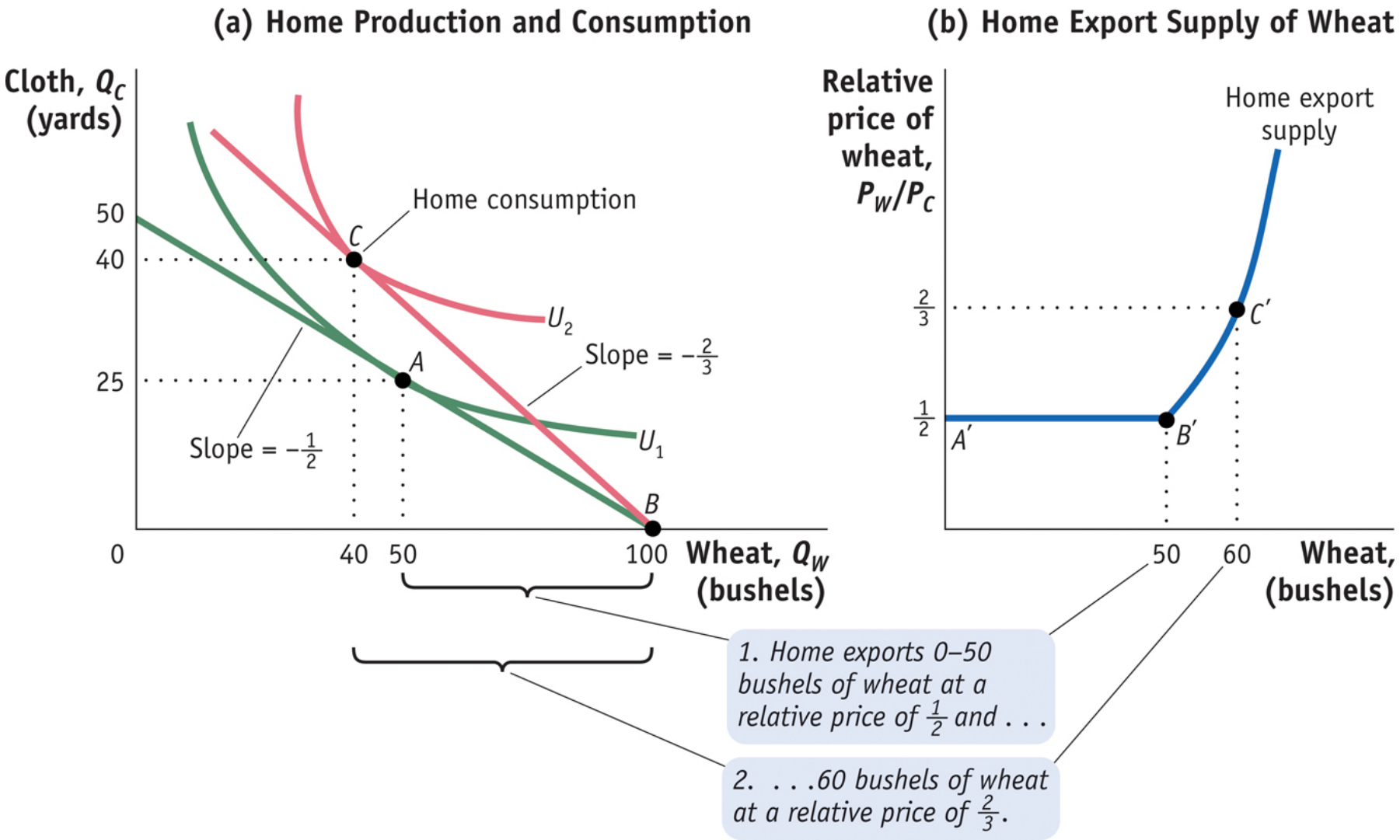
Labor Productivity and Wages: Time Series



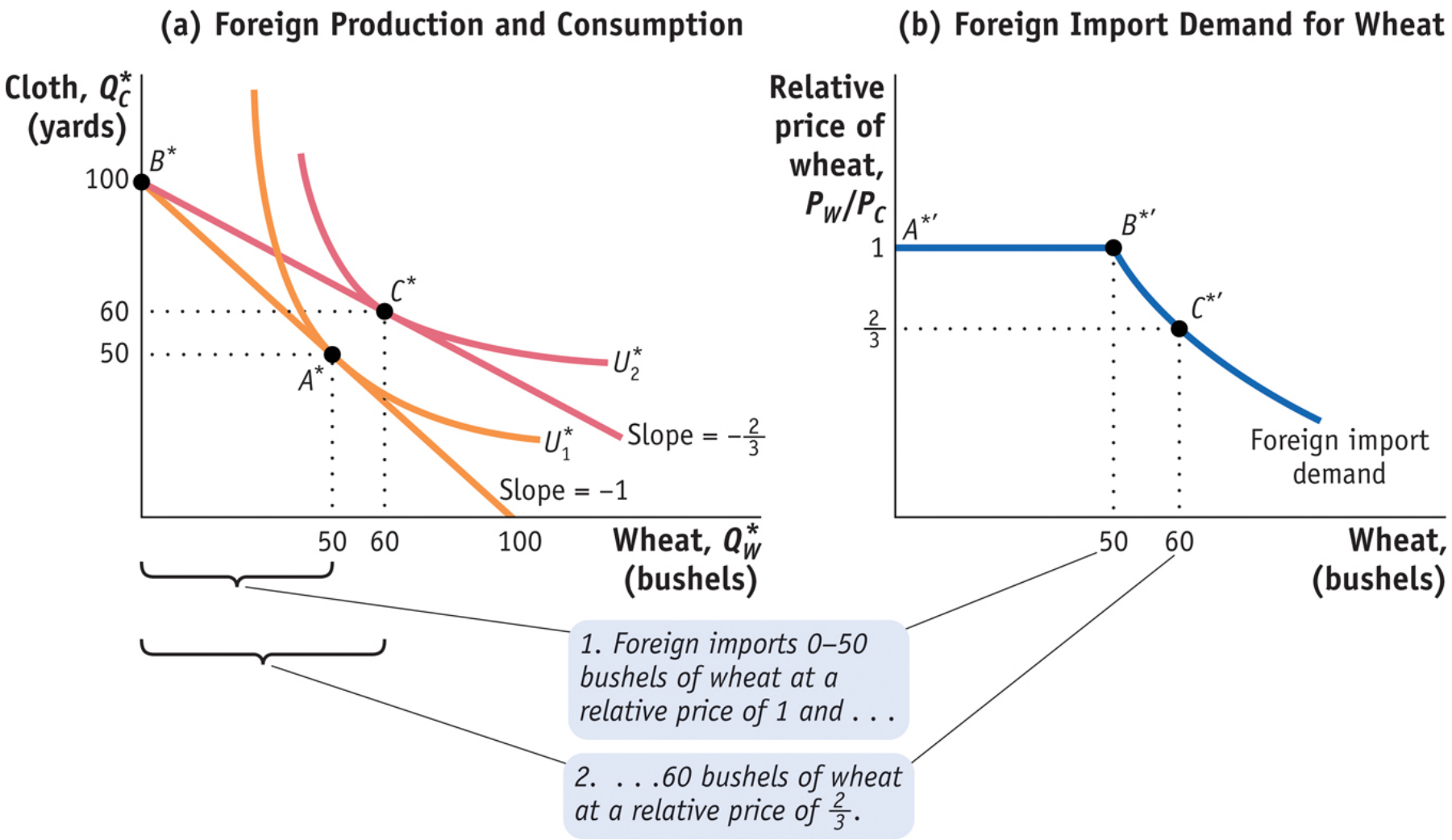
Finding International Trade Price

- So far we have assumed $\left(\frac{P_W}{P_C}\right)_T = \frac{2}{3}$
- But how do we find the equilibrium international price?
- We are going to derive Home export supply for wheat and Foreign import demand for wheat as a function of the relative price $\frac{P_W}{P_C}$
- At the equilibrium price, Home exports need to equal Foreign imports

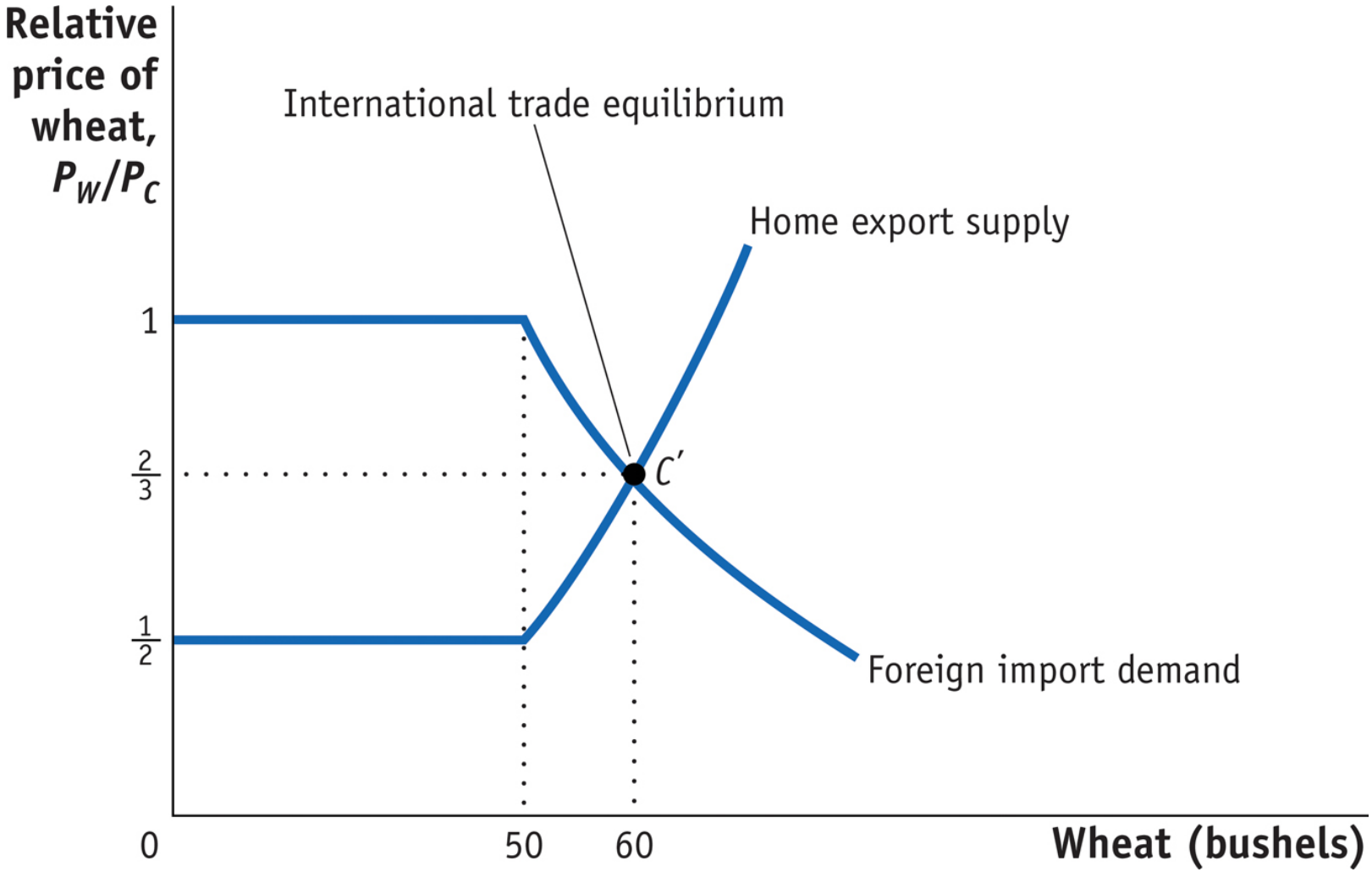
Home Wheat Export Supply



Foreign Wheat Import Demand



Equilibrium Determination



- If the world market for wheat is in equilibrium then so is the market for cloth. Why?

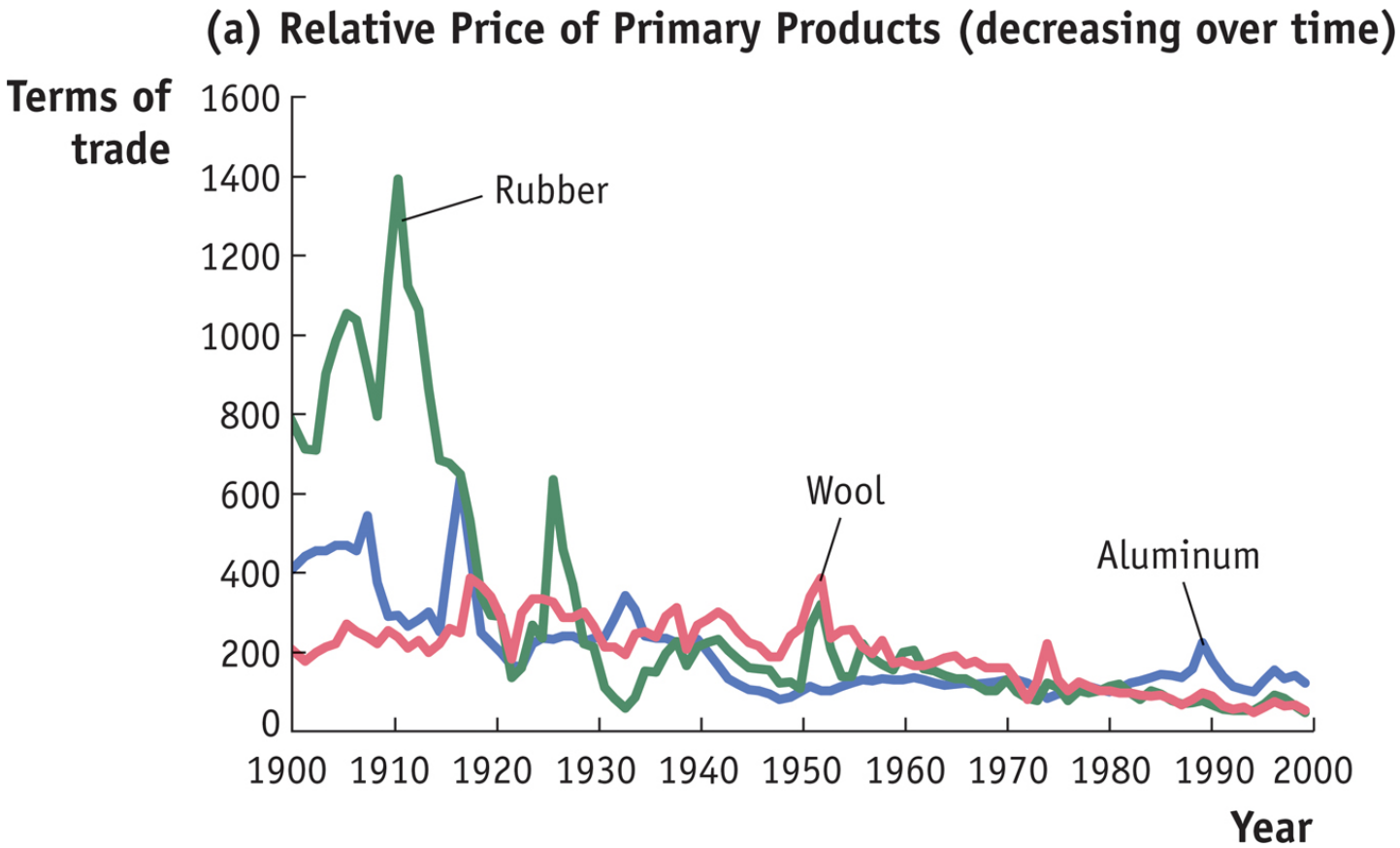
Terms of Trade

- **Terms of trade (ToT)** is the price of country's exports relative to the price of its imports
- Since Home exports wheat its ToT is $\left(\frac{P_W}{P_C}\right)_T$
- Since Foreign exports cloth its ToT is $1/\left(\frac{P_W}{P_C}\right)_T$
- An increase in ToT makes the country better off

Terms of Trade: Prebisch-Singer Hypothesis

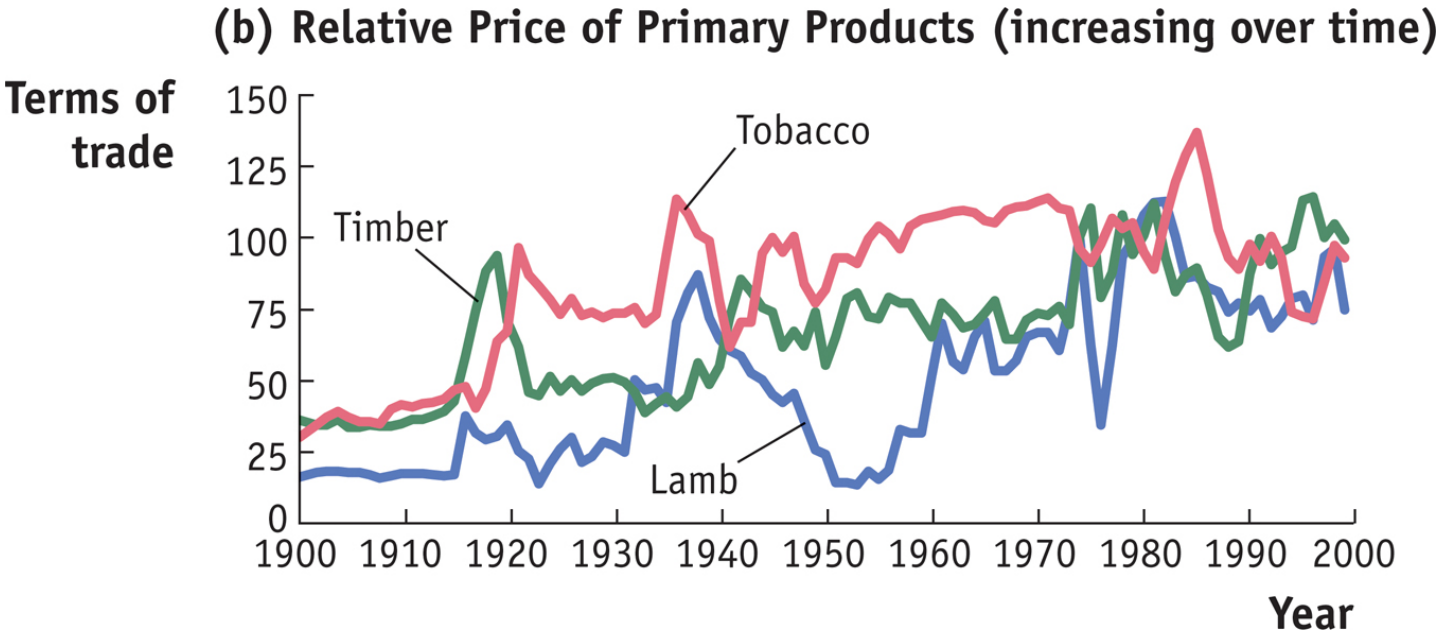
- In 1950s economists Hans Singer and Raul Prebisch hypothesized that the price of primary commodities (agricultural products and minerals) would decline relative to the price of manufactured products
- Since developing countries are often exporters of primary products and importer of manufactures this implies that their terms of trade should decline over time
- Arguments for the hypothesis:
  - As people and countries get richer they spend lower share of income on food (lowers relative demand for agriculture)
  - We find substitutes for minerals in the manufacturing process (lowers relative demand for minerals)
- Arguments against the hypothesis:
  - Faster technological progress in manufactures makes them relatively cheaper to produce
  - Supply of commodities might be restricted by international cartels (oil and OPEC)

Terms of Trade: Prebisch-Singer Hypothesis



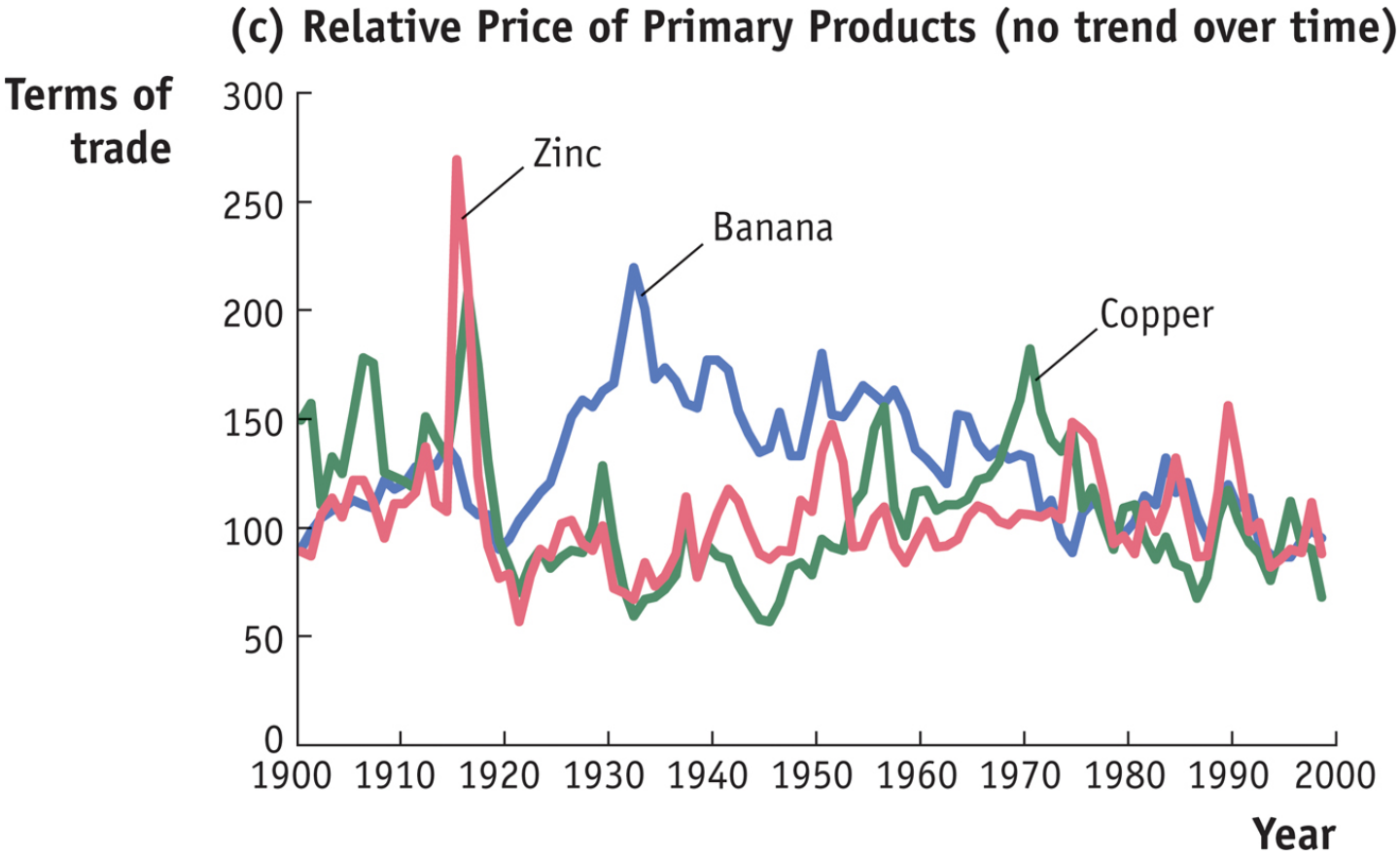
- Relative price of some primary products has declined over time...

Terms of Trade: Prebisch-Singer Hypothesis



- while for others it has increased over time...

Terms of Trade: Prebisch-Singer Hypothesis



- while for others still it has shown no clear trend over time
- Overall there is no strong general support for the hypothesis

Key Points from the Ricardian Model

- Comparative Advantage determines the pattern of trade (i.e. what countries export/import)
  - Countries export what is cheap under autarky
- Countries are better off under trade because they can specialize and import products at a lower price
  - Country gains from trade even if the trading partner has better technology for producing both goods
- Absolute advantage (i.e. productivity) determines real wages