

Economics 101 – Fall 2008

# Comparative Advantage Due to Endowment Differences

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# Introduction

Ricardian model explains trade by differences in productivity

Heckscher-Ohlin model argues that differences in *factors of production* create differences between countries

- ▶ e. g. labor, labor skills, capital, land, natural resources, etc.
- ▶ Interaction between *relative abundance* of factors of production and *relative intensity* of which factors are used in different production processes

Similarities: cross-country differences generate differences in relative autarky prices

- ▶ Comparative advantage emerges and there will be gains from trade

Added value: richer predictions, distributional issues

# The Heckscher-Ohlin Trade Model

- ▶ Two countries: Home and Foreign (denoted  $*$ )
- ▶ Two goods: cloth ( $C$ ) and food ( $F$ )
- ▶ Two factors of production: labor ( $L$ ) and land ( $T$ ), fixed
- ▶ Key force: differences in factor endowments
  - ▶ Both countries have identical technology
- ▶ All markets are competitive:
  - ▶ Agents take prices and wages as given
  - ▶ Workers paid their marginal product

# Choice of Inputs

When there is more than one factor of production:

- ▶ Opportunity cost in production is no longer constant
- ▶ PPF is no longer a straight line.

Two factors of production, labor services and land

$a_{TC}$  = acres of land used to produce one unit of cloth

$a_{LC}$  = hours of labor used to produce one unit of cloth

$a_{TF}$  = acres of land used to produce one calorie of food

$a_{LF}$  = hours of labor used to produce one calorie of food

# Factor Intensity

Assume that cloth uses labor in production more than cloth does and that food uses land in production more than does food:

$$a_{LC}/a_{TC} > a_{LF}/a_{TF}$$

$$a_{LC}/a_{LF} > a_{TC}/a_{TF}$$

In such case, we say that:

- ▶ Cloth production is
- ▶ Food production is

Assume, for now, that the  $a$ s are fixed—production requires fixed quantities of land and labor

# Production Possibilities I

With 2 factors, production possibilities are influenced by *both* land and labor:

$$(4-3) \quad a_{TF}Q_F + a_{TC}Q_C \leq T$$

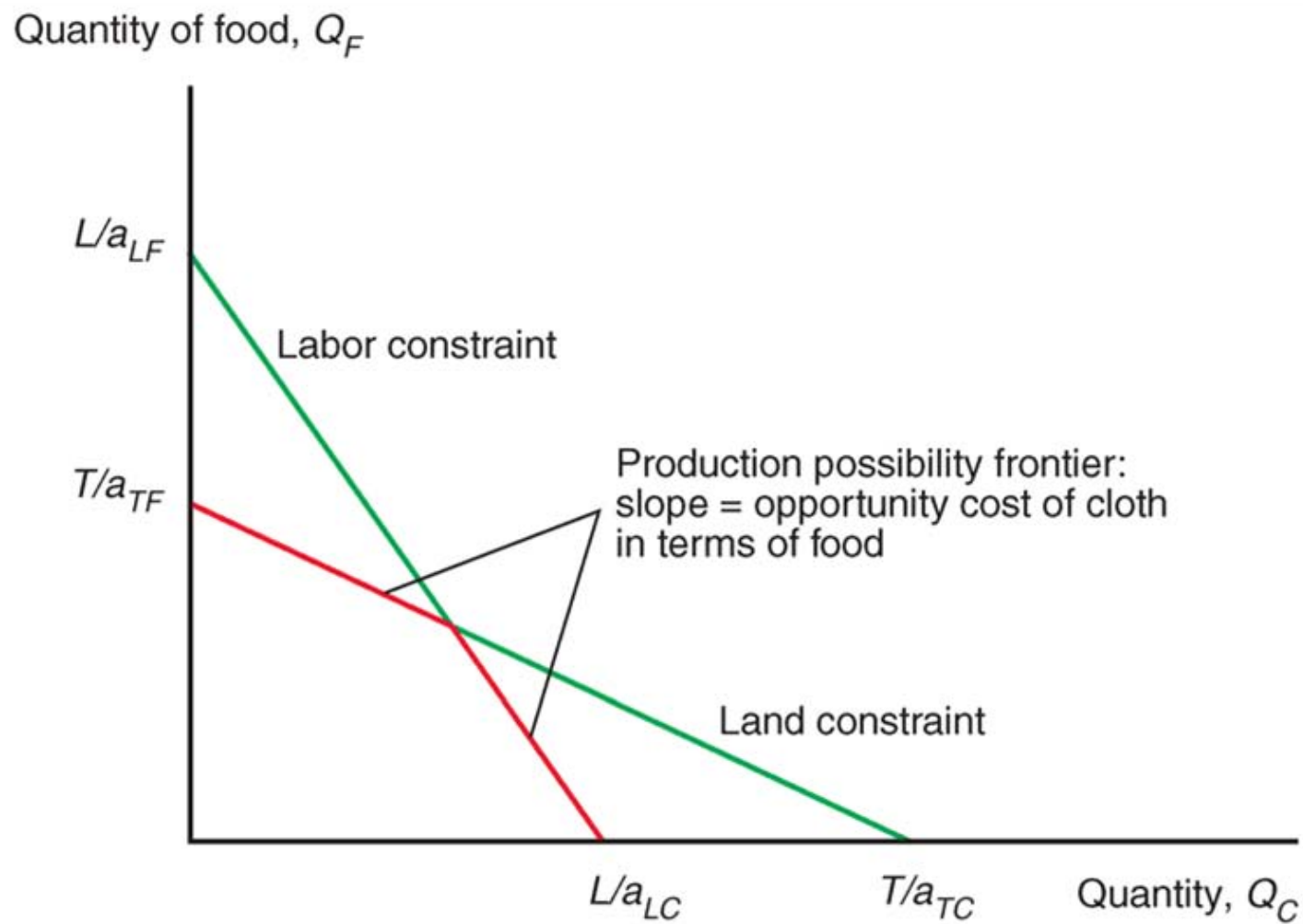
and

$$(4-4) \quad a_{LF}Q_F + a_{LC}Q_C \leq L$$

$L$  = total supply of labor services

$T$  = total supply of land

# Fig. 4-1: The PPF without Factor Substitution



# Production Possibilities II

The opportunity cost of producing cloth in terms of food is **not** constant in this model:

- ▶ OC is *low* when the economy produces low amount of cloth and a high amount of food
- ▶ OC is *high* when the economy produces a high amount of cloth and a low amount of food

Why?

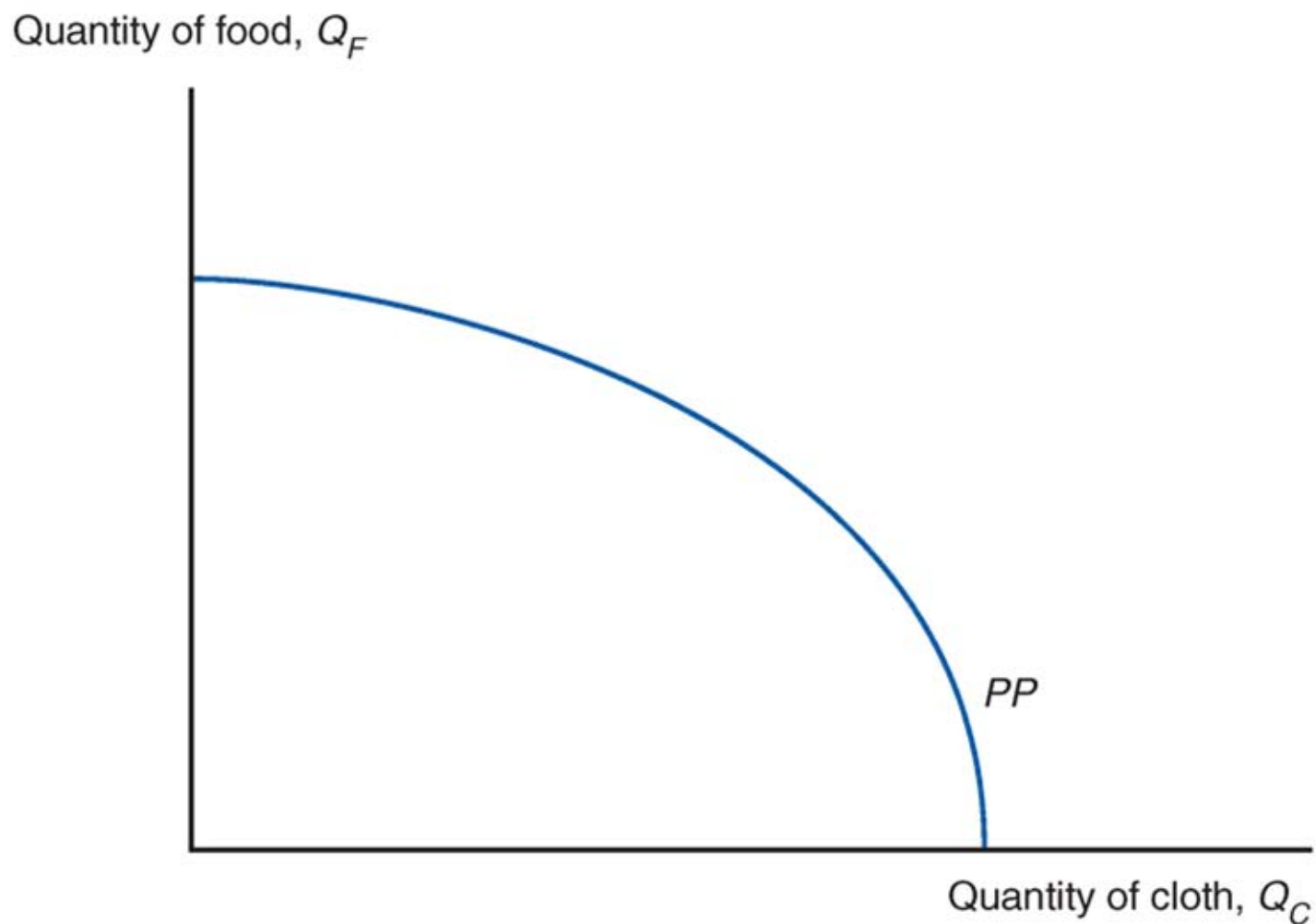
## Production Possibilities III

Now assume producers can substitute one input for another in the production process

The PPF is curved, forming a convex production possibilities set

- ▶ e. g., many workers could work on a small plot of land or a few workers could work on a large plot of land to produce the same amount of output
- ▶ Unit factor requirements vary at every quantity of cloth and food
- ▶ Slope of PPF is **marginal rate of transformation**
- ▶ Implies that autarky prices not uniquely determined by supply side

# Fig. 4-2: The PPF with Factor Substitution



# Production and Prices

The PPF describes what an economy *can* produce, but to determine what it *does* produce we need prices

Perfect competition and profit maximization imply that the economy produces at the point that maximizes the value of production,  $V$ :

$$V = P_C Q_C + P_F Q_F,$$

where

$P_C$  = price of cloth

$P_F$  = price of food

## Production and Prices II

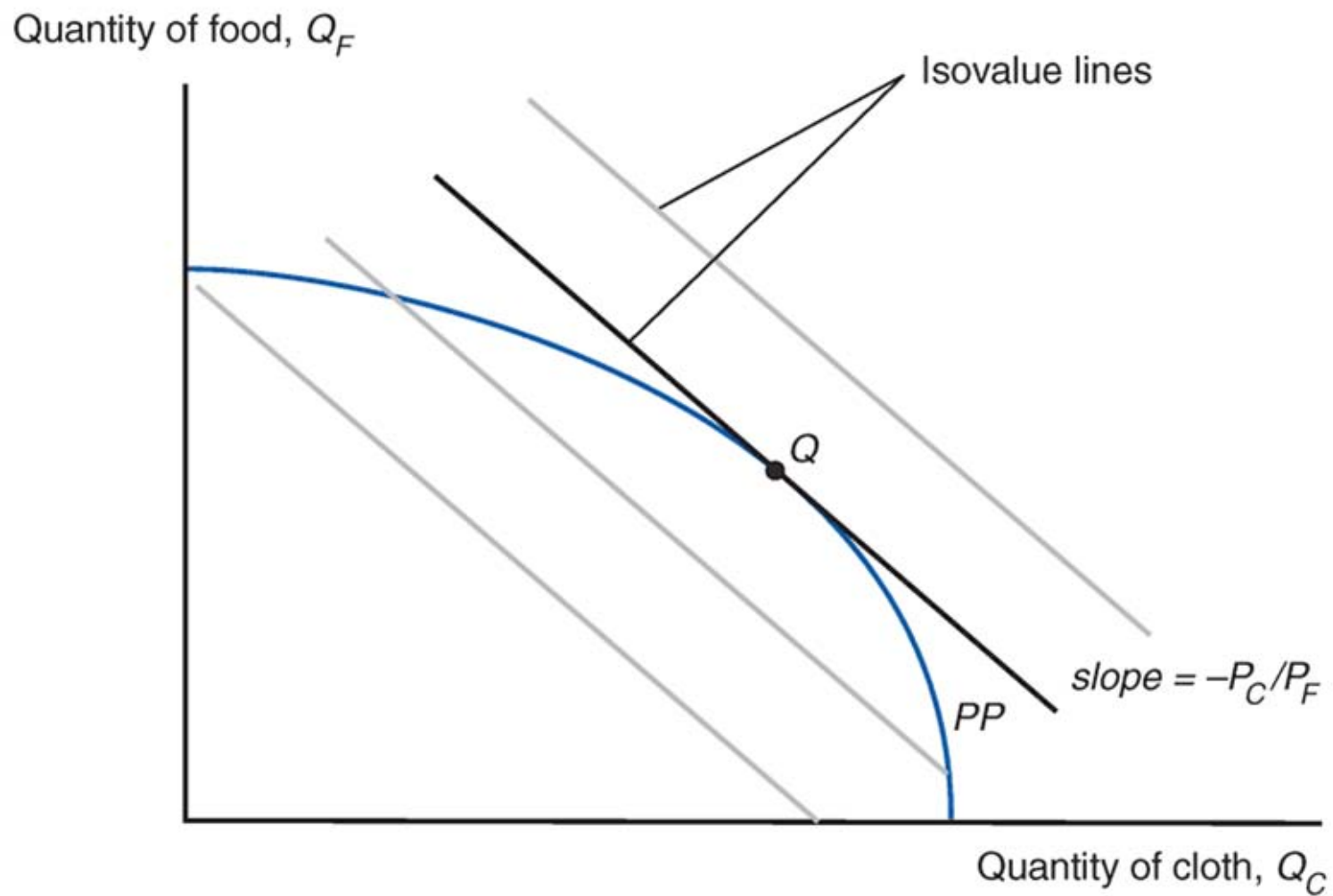
Define an **isovalue line** as the set of quantities  $Q_C$  and  $Q_F$  representing a constant value of production,  $\bar{V}$

Rewrite the previous equation for  $\bar{V} = P_C Q_C + P_F Q_F$  as

$$P_F Q_F = \bar{V} - P_C Q_C$$

$$Q_F = \bar{V}/P_F - (P_C/P_F)Q_C$$

# Fig. 4-3: Prices and Production



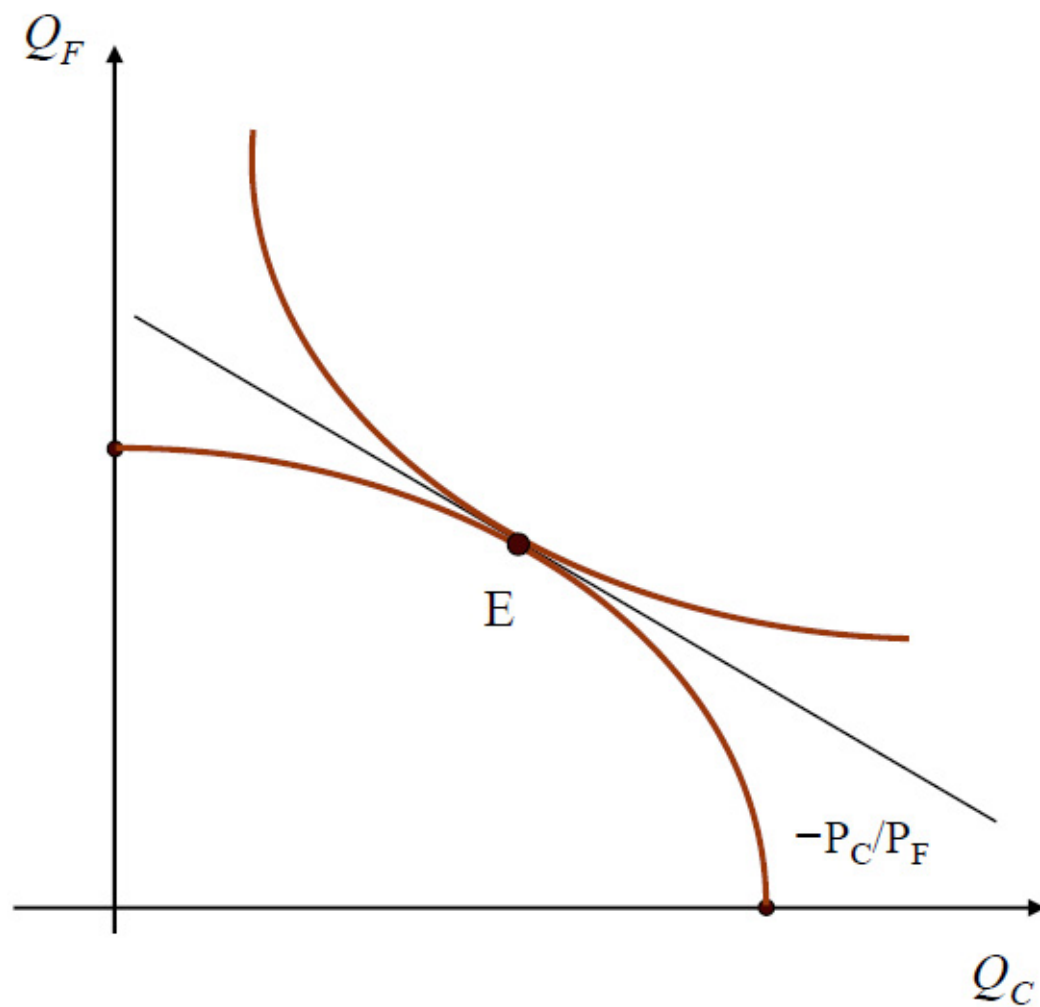
## Production and Prices III

Given prices of output, a point on one isovalue line represents the maximum value of production, say at a point  $Q$

- ▶ At  $Q$  the slope of the PPF equals  $-P_C/P_F$
- ▶ Or, the opportunity cost of cloth equals the relative price of cloth
- ▶ The optimal trade-off in production equals the trade-off represented by market prices

Optimal production point is where the slope of the PPF ( $-dQ_C/dQ_F$ ) equals the relative price ratio  $P_C/P_F$

# Sketch of General Equilibrium in Autarky



Source: Antras (2007)

# Toward Free-Trade Equilibrium

Key Question: How do relative factor endowments affect relative prices under autarky?

Or, how do differences in factor endowments lead to comparative advantage?

We answer this in 4 links:

1. Factor input choice and factor prices
2. Factor prices and relative goods prices
3. Factor endowments and relative output levels
4. Relative output levels and relative goods prices

# Factor Input Choice and Factor Prices I

Producers may choose different amounts of factors of production used to make cloth or food

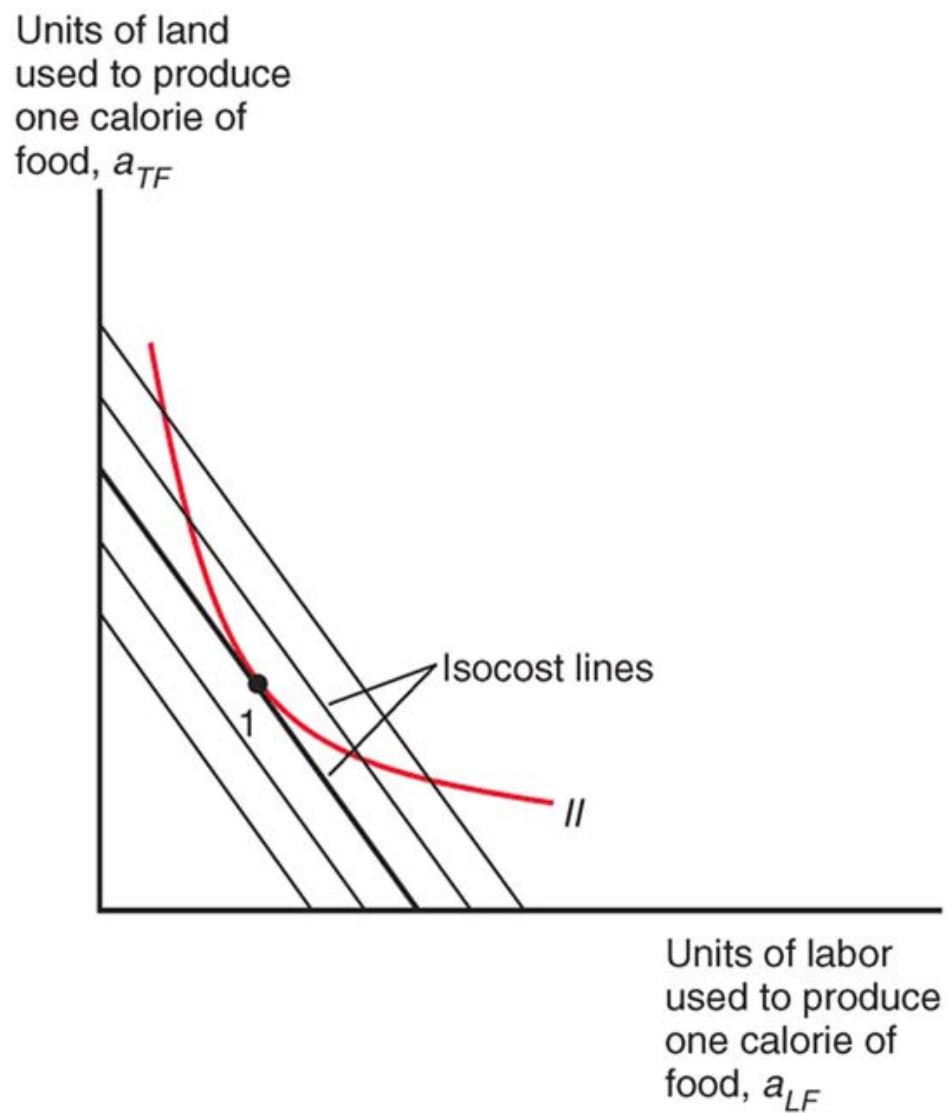
Choice of inputs depends on the wage rate ( $w$ ) and rental rate for land ( $r$ )

- ▶ Price of  $a_{LF}$  units of labor is  $a_{LF} \times w$
- ▶ Price of  $a_{TF}$  units of land is  $a_{TF} \times r$

An **isocost line** is

$$K = a_{LF}w + a_{TF}r$$

# Fig. 4A-1: Optimal Land-Labor Ratio



## Factor Input Choice and Factor Prices II

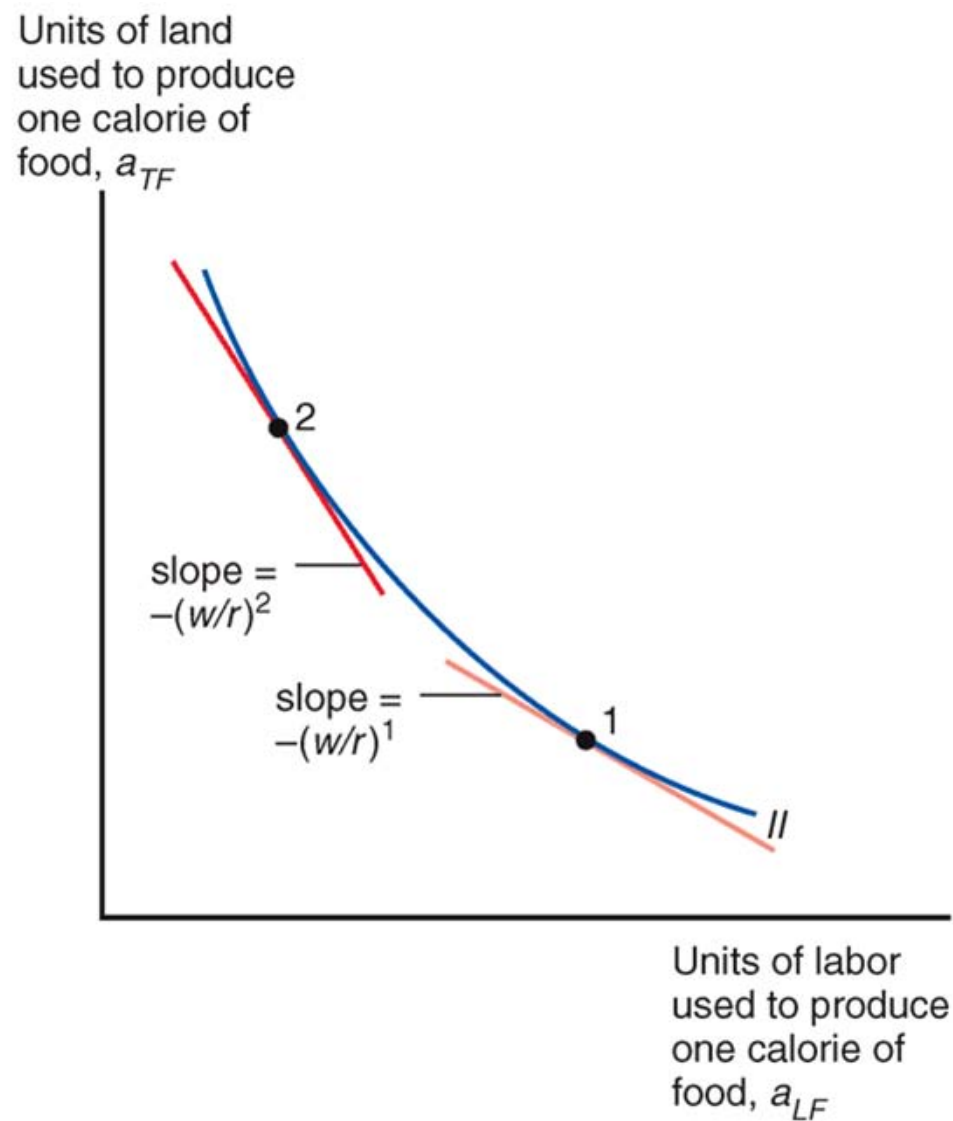
What happens if  $w/r$  increases?

- ▶ As the  $w$  increases relative to  $r$ , producers want to use labor and land
- ▶ This implies  $a_{TF}/a_{LF}$  goes

We can depict this relationship on a graph in relative terms

- ▶ Remember: food is land intensive, cloth is labor intensive

# Fig. 4A-2: Changing the Wage-Rental Ratio



# Factor Input Choice and Factor Prices II

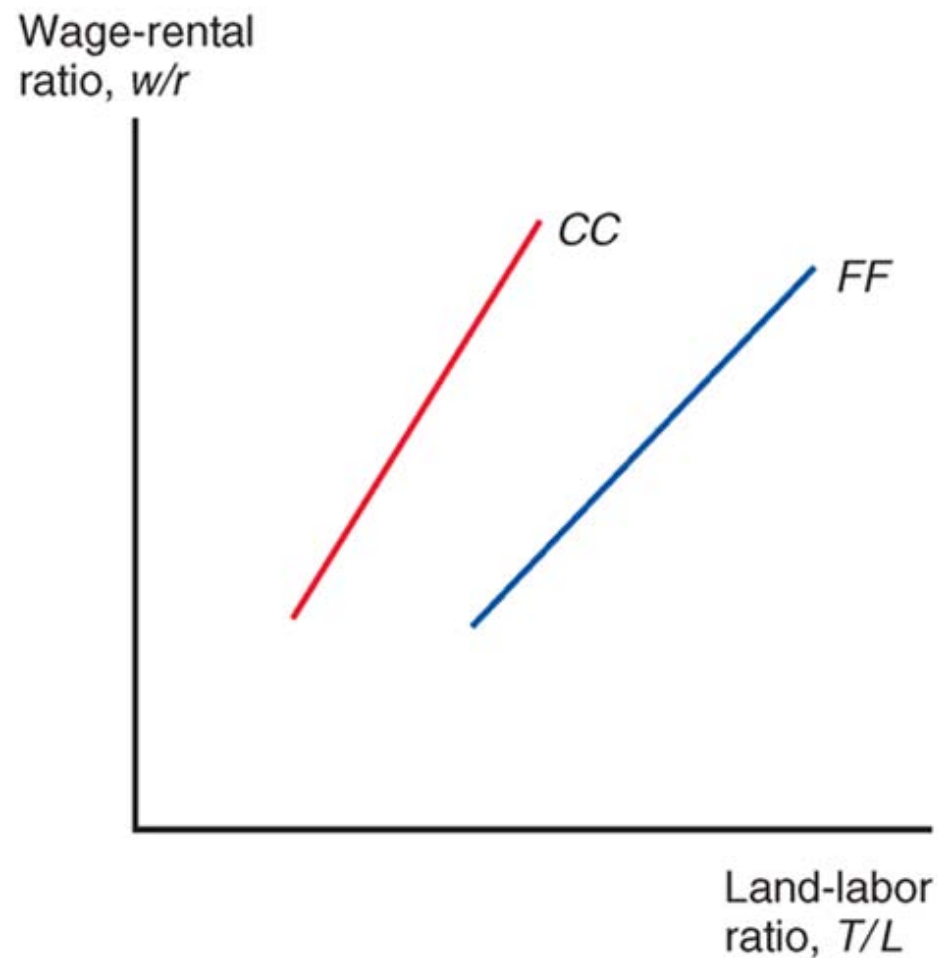
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We can depict this relationship on a graph in relative terms

- ▶ Remember: food is land intensive, cloth is labor intensive

# Fig. 4-5: Factor Prices and Input Choices



## Factor Input Choice and Factor Prices III

- ▶ The effect of changes in the wage rate depend on the intensity of labor services in production
- ▶ The effect of changes in the rental rate depend on the intensity of land usage in production
- ▶ An increase in the rental rate should affect the price of food than the price of cloth since food is the land intensive industry
- ▶ Changes in  $w/r$  are therefore directly related to changes in  $P_C/P_W$

# Factor Prices and Goods Prices I

Under perfect competition goods prices must equal unit costs:

$$P_C = a_{LC}w + a_{TC}r$$

$$P_F = a_{LF}w + a_{TF}r$$

What happens if  $P_C/P_F$  increases?

If factor requirements are independent of factor prices:

$$\frac{P_C}{P_F} = \frac{a_{LC}(w/r) + a_{TC}}{a_{LF}(w/r) + a_{TF}}$$

Notice: right-hand side increases in  $(w/r)$  if  $a_{TF}/a_{LF} > a_{TC}/a_{LC}$

# Fig. 4-6: Factor Prices and Goods Prices



## Factor Prices and Goods Prices II

Theory predicts changes in the distribution of income when the relative price of goods changes

An increase in the relative price of cloth ( $P_C/P_F$ ):

- ▶ Raises income of workers relative to that of landowners ( $w/r$ )
- ▶ Raises the ratio of land to labor ( $T/L$ ) used in both industries
- ▶ Raises the marginal product of labor and lowers the marginal product of land in both industries
- ▶ Raises the real income of workers and *lowers* the real income of land owners

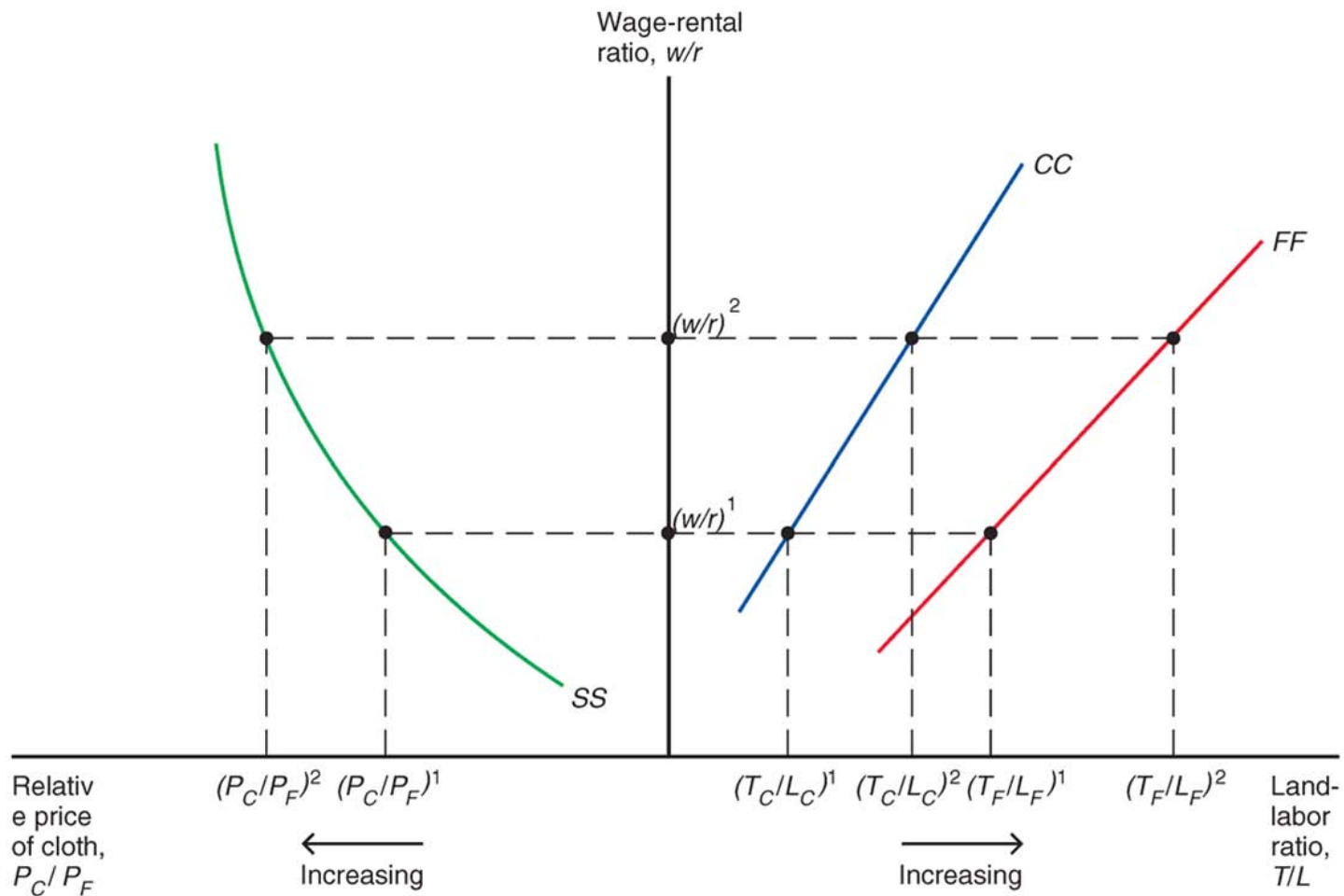
# Factor Prices and Goods Prices II

## Stolper-Samuelson Theorem:

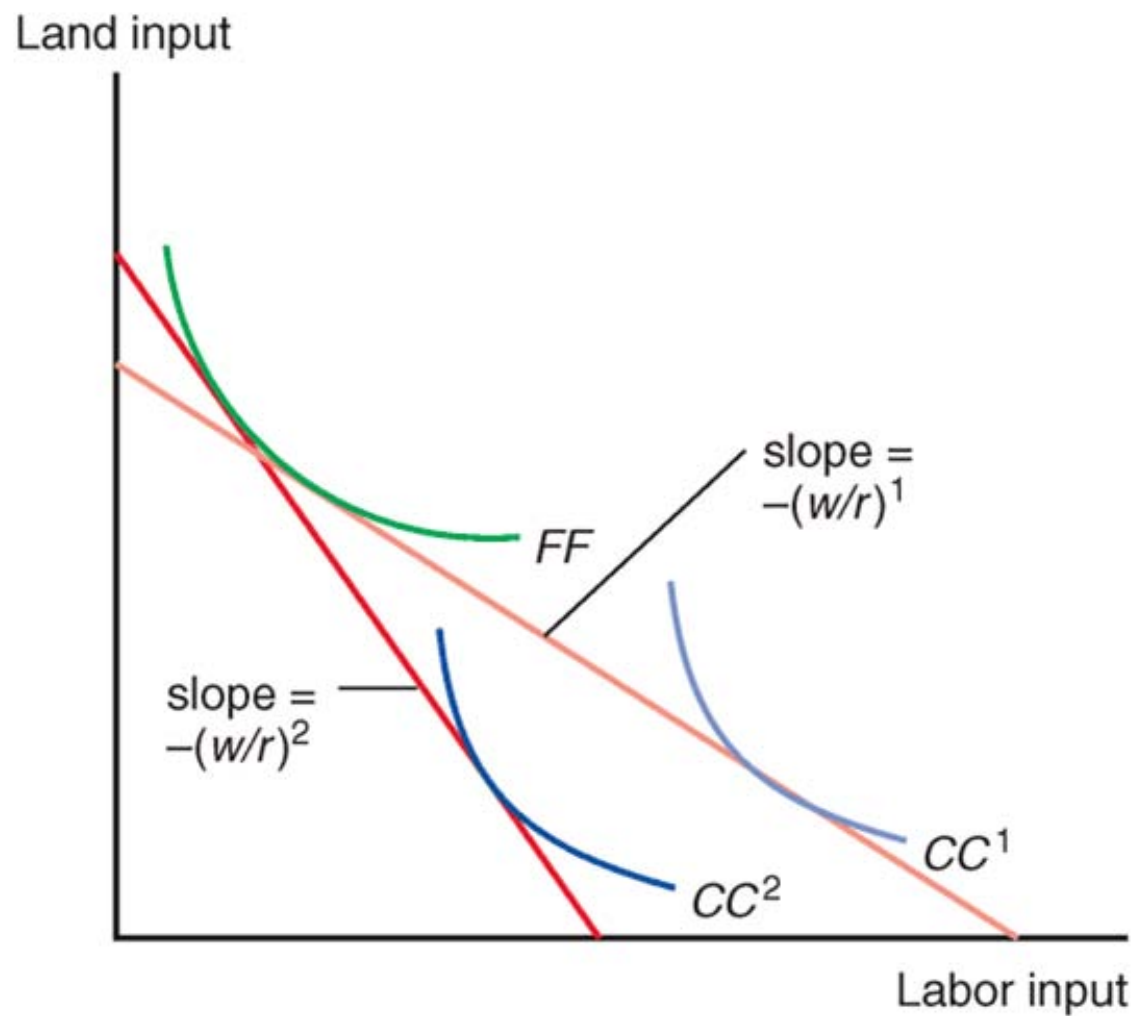
Why the stronger statement?

- ▶ Increasing  $w/r$  implies  $a_{TF}/a_{LF}$  and  $a_{TC}/a_{LC}$  also increase
- ▶ This implies that  $w/P_C$  and  $w/P_F$  must increase and  $r/P_C$  and  $r/P_F$  must fall

# Fig. 4-7: From Goods Prices to Input Choices



# Fig. 4A-4: A Rise in the Price of Cloth



# Factor Endowments and Output Levels I

Output levels have to be consistent with factor market clearing:

$$Q_C a_{TC} + Q_F a_{TF} = T$$

$$Q_C a_{LC} + Q_F a_{LF} = L$$

We can write this as

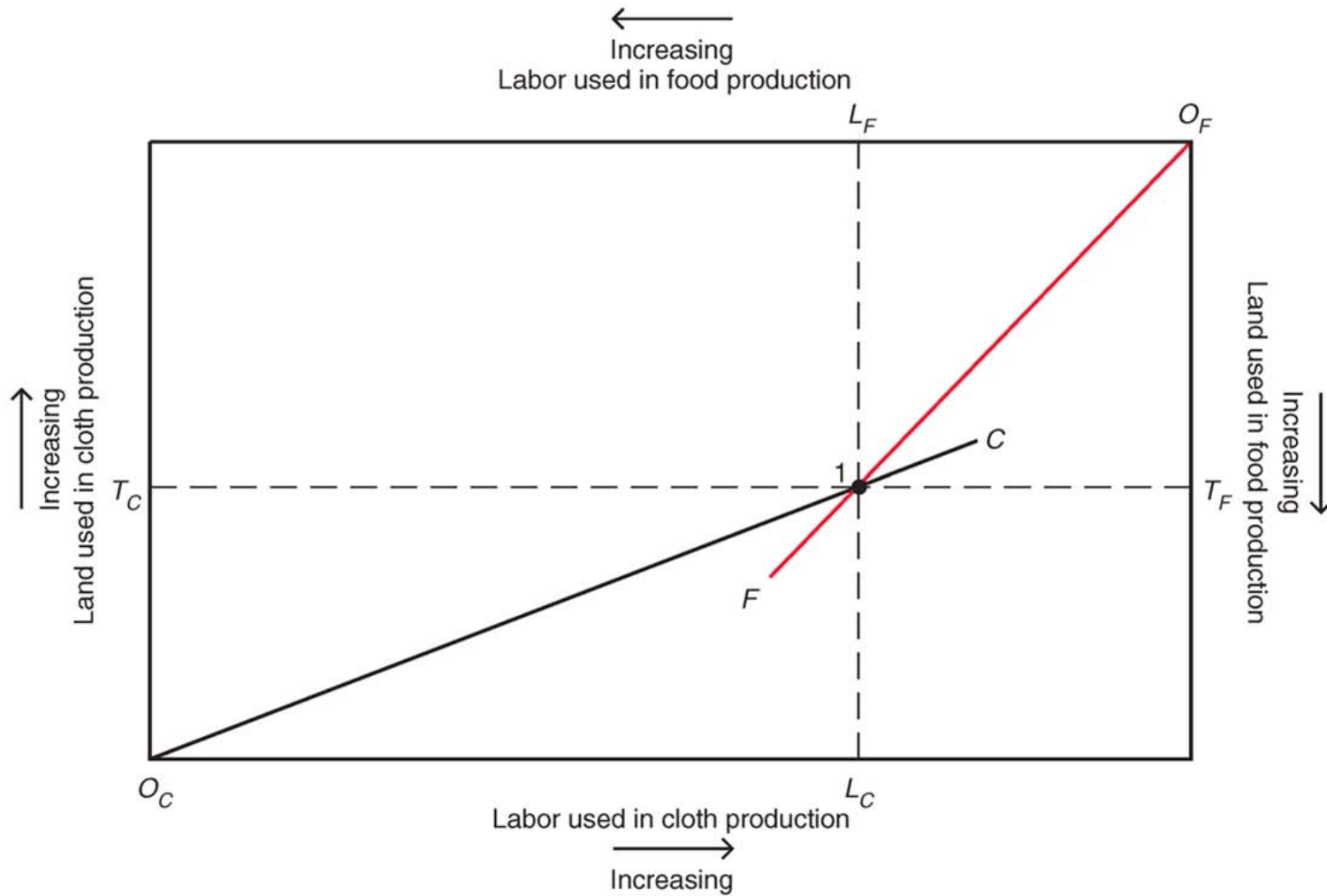
$$\frac{a_{TC} + (Q_F/Q_C)a_{TF}}{a_{LC} + (Q_F/Q_C)a_{LF}} = \frac{T}{L}$$

Suppose  $P_C/P_F$  is given

(implies  $w/r$  and factor requirements are constant)

We represent the amount of factors used in the production of different goods in the following diagram

# Fig. 4-8: The Allocation of Resources



## Factor Endowments and Output Levels II

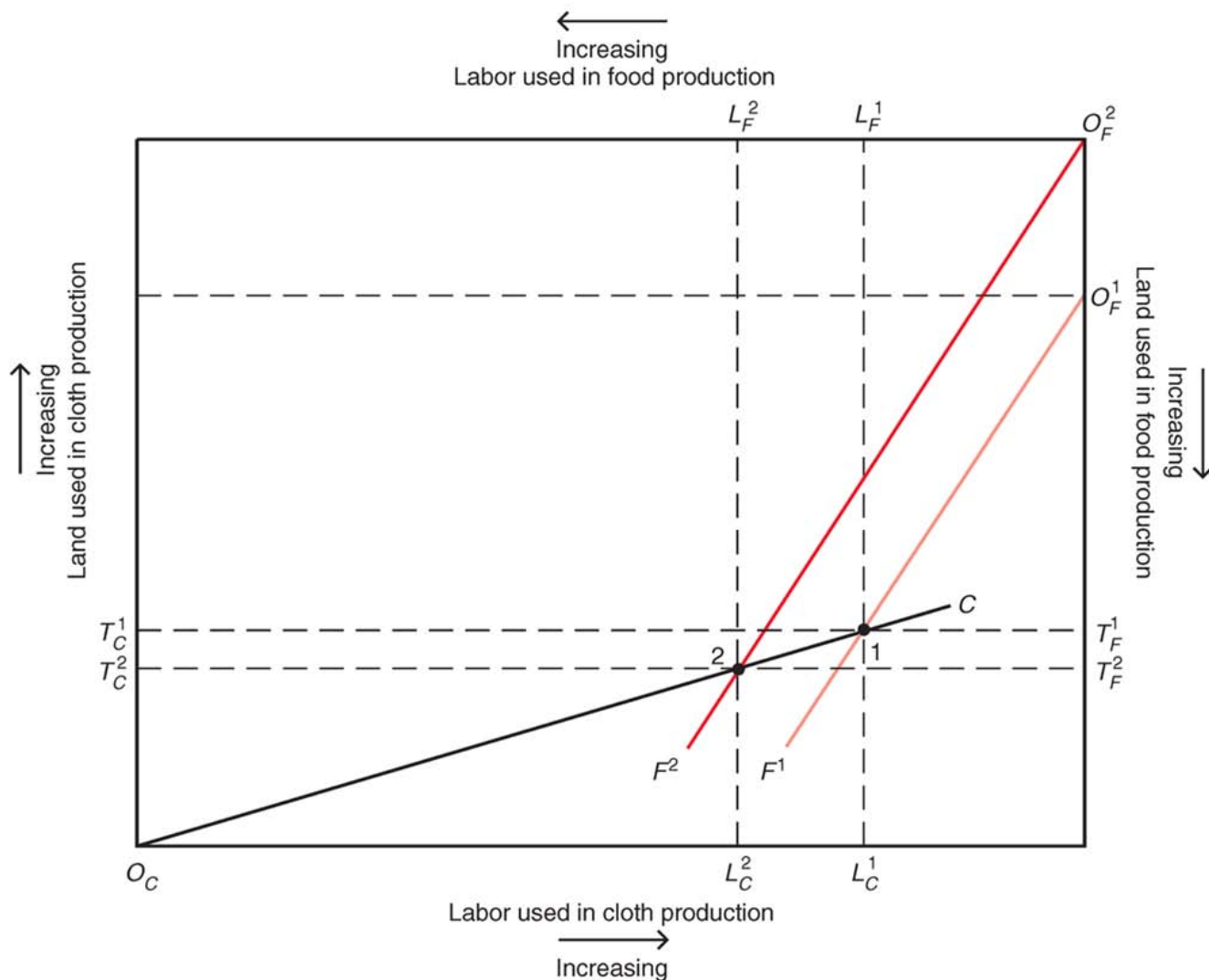
How do levels of output change when the economy's resources change? What happens to  $Q_C$  and  $Q_F$  when  $T/L$  increases?

If  $P_C/P_F$  is given, then  $Q_F/Q_C$  has to increase

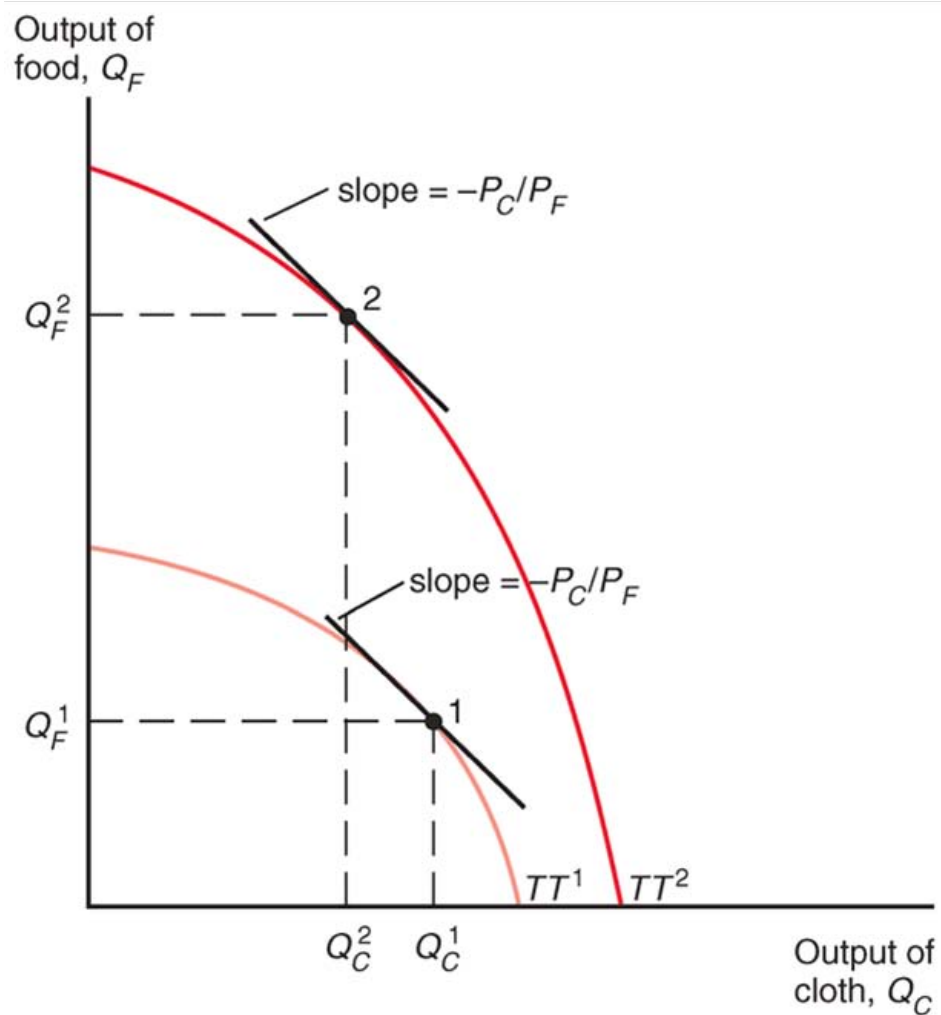
But we can say more:

The **Rybczynski theorem** states that

# Fig. 4-9: An Increase in the Supply of Land



# Fig. 4-10: Resources and Production Possibilities



# Output Levels and Goods Prices

The biased effect of an increase in resources on production possibilities is the key to understanding how differences in resources give rise to international trade

Think: What happens to the relative supply of land and labor when the countries trade?

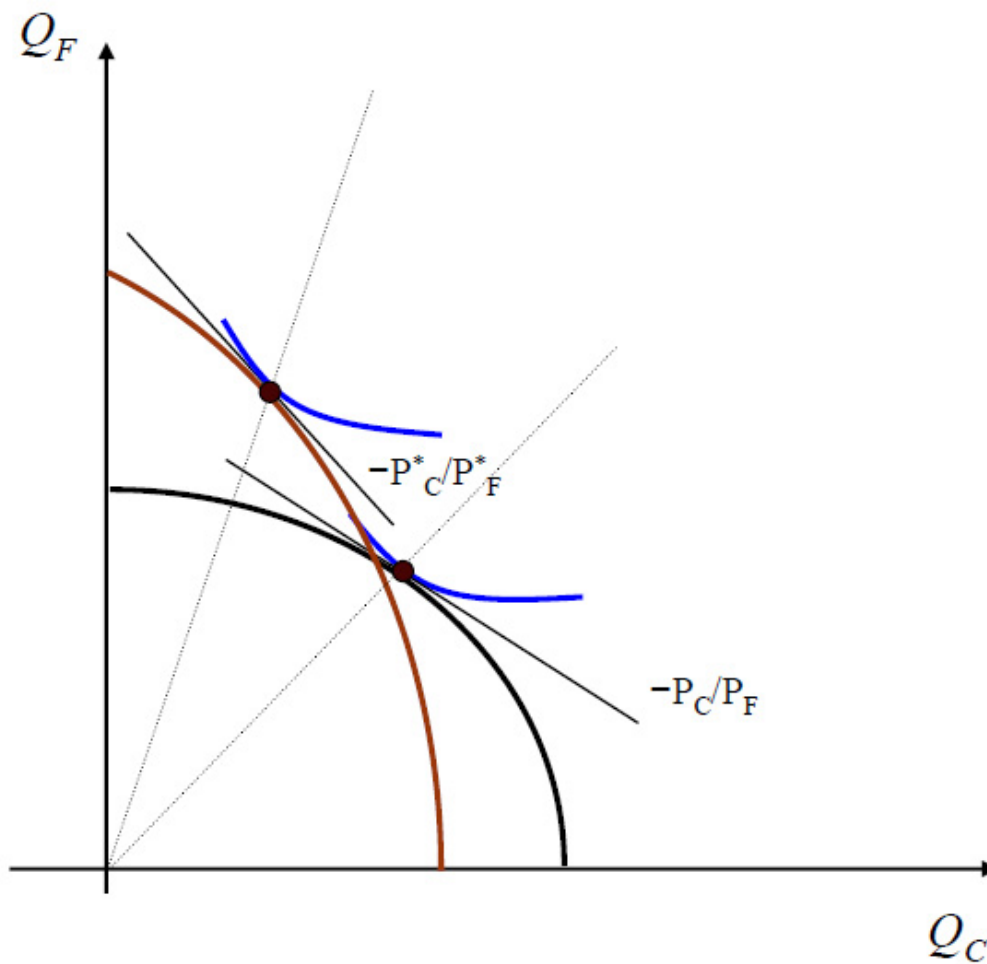
# Output Levels and Goods Prices

An economy with a high ratio of land to labor services ( $T/L$ ) will have a higher output of food relative to cloth and a higher price of food relative to cloth

It will be relatively efficient (have a comparative advantage) in

Key insight of Heckscher-Ohlin model:

# Autarky Equilibrium



Source: Antras (2007)

# Trade in the Heckscher-Ohlin Model

Suppose Home is **relatively abundant** in labor and Foreign is **relatively abundant** in land:

Countries have the same production technologies and same consumer preferences

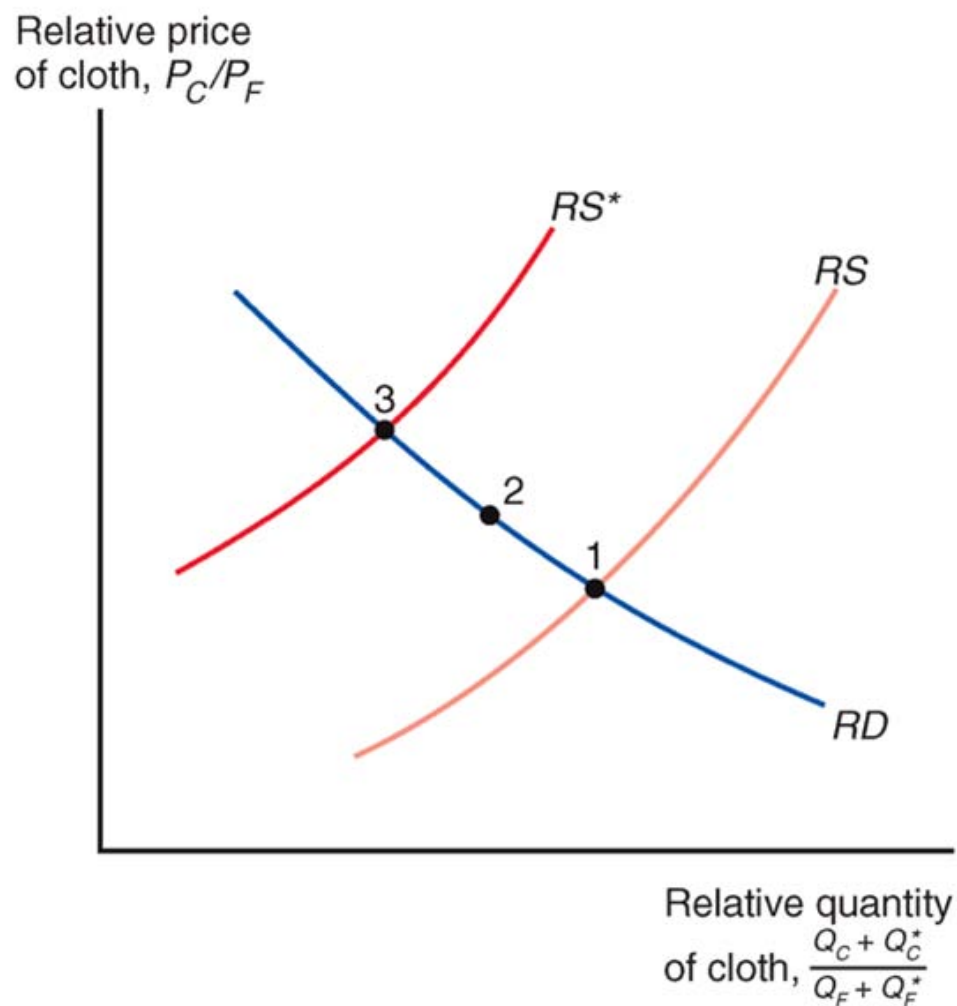
- ▶ Because the domestic country is *labor abundant*, it will have a comparative advantage at producing cloth because cloth is *labor intensive*
- ▶ The autarky relative price of cloth (the labor-intensive good) is \_\_\_\_\_ at Home than in Foreign:

## Trade in the Heckscher-Ohlin Model II

Since cloth is the labor-intensive good, the Home's PPF allows Home to produce a higher ratio of cloth to food relative to Foreign

- ▶ At each relative price, Home produces a higher ratio of cloth to food than Foreign
- ▶ Like the Ricardian model, the Heckscher-Ohlin model predicts a convergence of relative prices with trade

# Fig. 4-11: Trade and Relative Price Convergence



## Trade in the Heckscher-Ohlin Model III

- ▶ Note that at a common relative price  $P_C/P_F$ , Home has a larger relative supply of cloth
- ▶ Trade will lead to a convergence of relative prices, so  $P_C/P_F$  goes up at Home and falls in Foreign
  - ▶ The rise in  $P_C/P_F$  at Home leads to a      in the relative production of cloth and a      in relative consumption of cloth
- ▶ At point 2, Home has  $RS > RD$  while Foreign has  $RS^* < RD$ 
  - ▶ Home becomes an exporter of      and an importer of

# Heckscher-Ohlin Theorem

## Heckscher-Ohlin Theorem:

- ▶ Home (labor-abundant) exports the labor-intensive good (cloth) and imports the land-intensive good (food)
- ▶ Foreign (land-abundant) exports the land-intensive good (food) and imports the labor-intensive good (cloth)

## Balanced Trade I

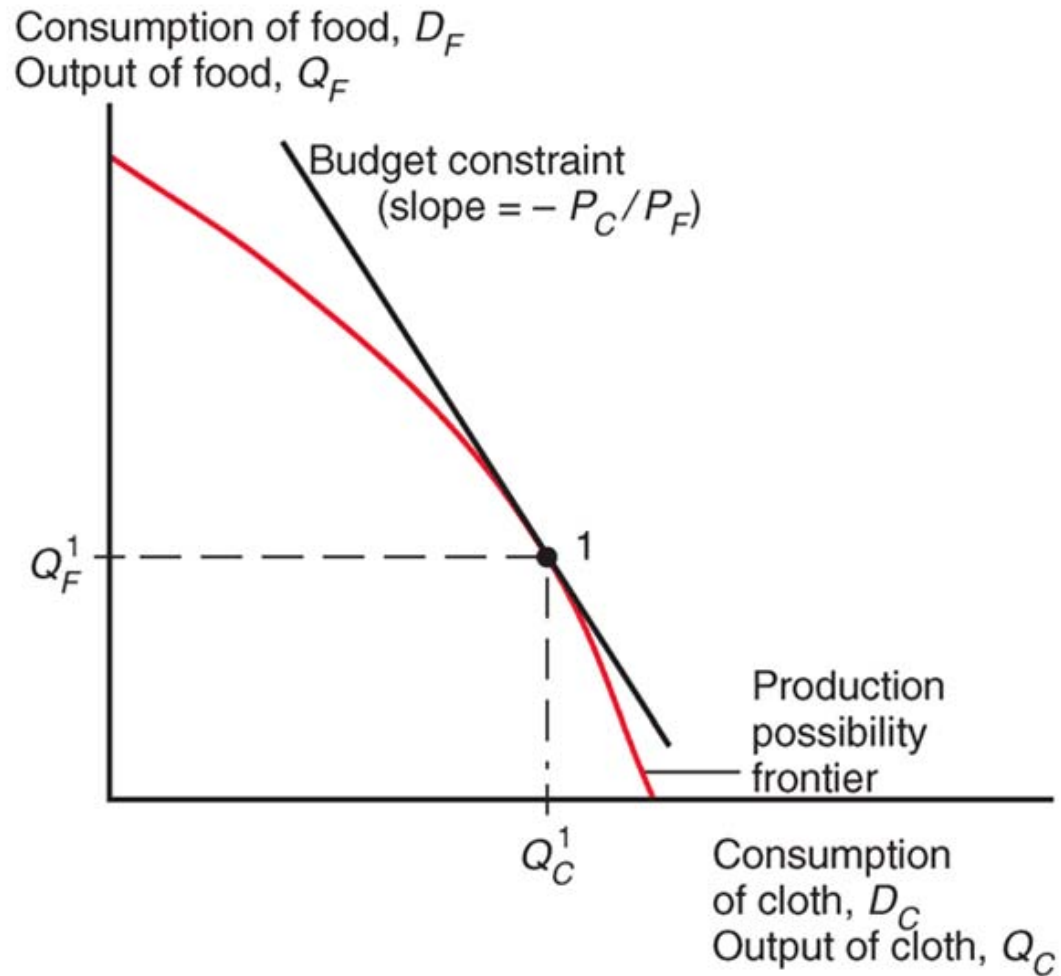
The value of goods consumed must equal the value of goods produced for each country:

$$P_C D_C + P_F D_F = P_C Q_C + P_F Q_F$$

where  $D_C$  = Home demand of cloth and  $D_F$  = Home demand of food

- ▶ Alternatively:
- ▶ This equation is the budget constraint for an economy, slope =

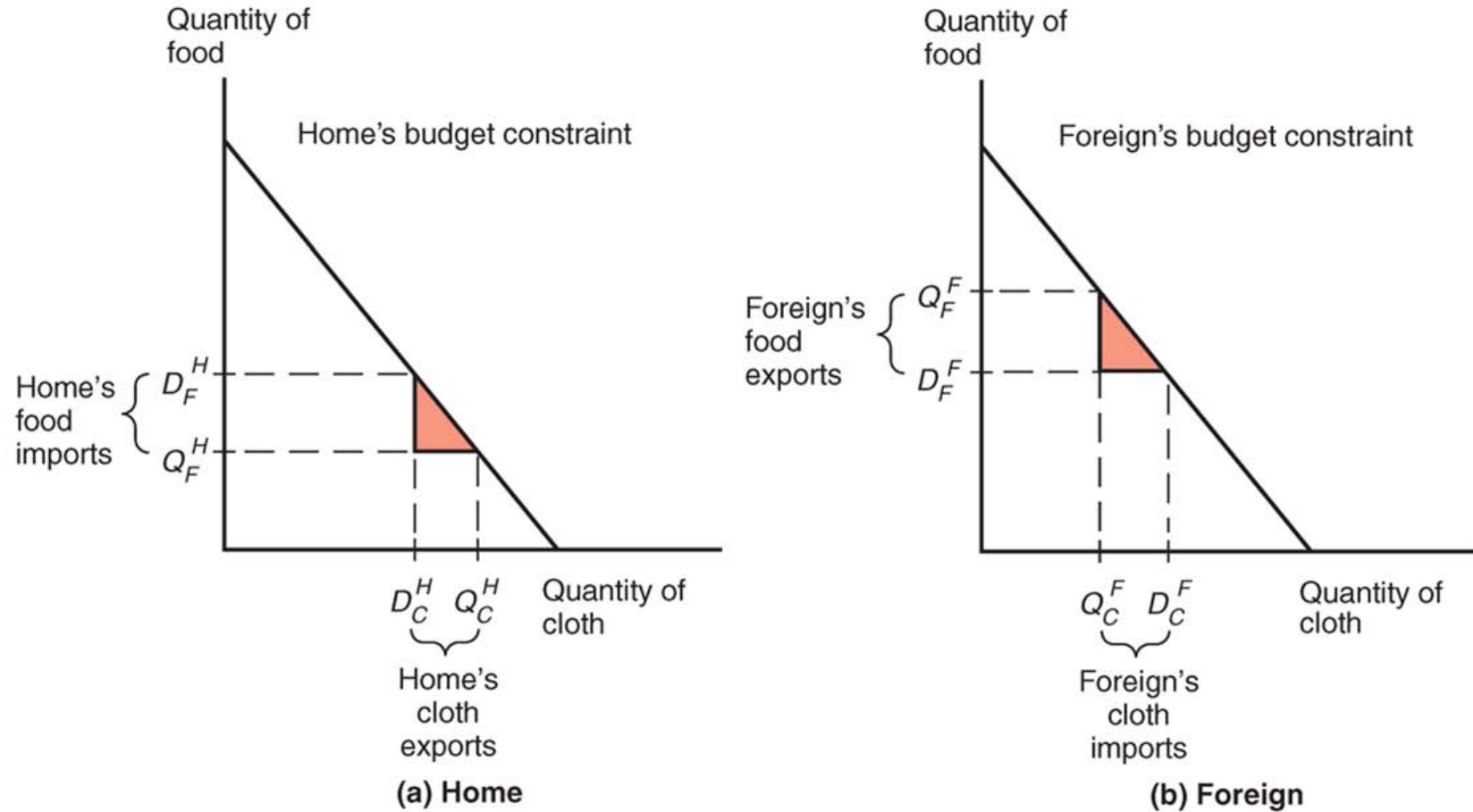
# Fig. 4-12: Budget Constraint for a Trading Economy



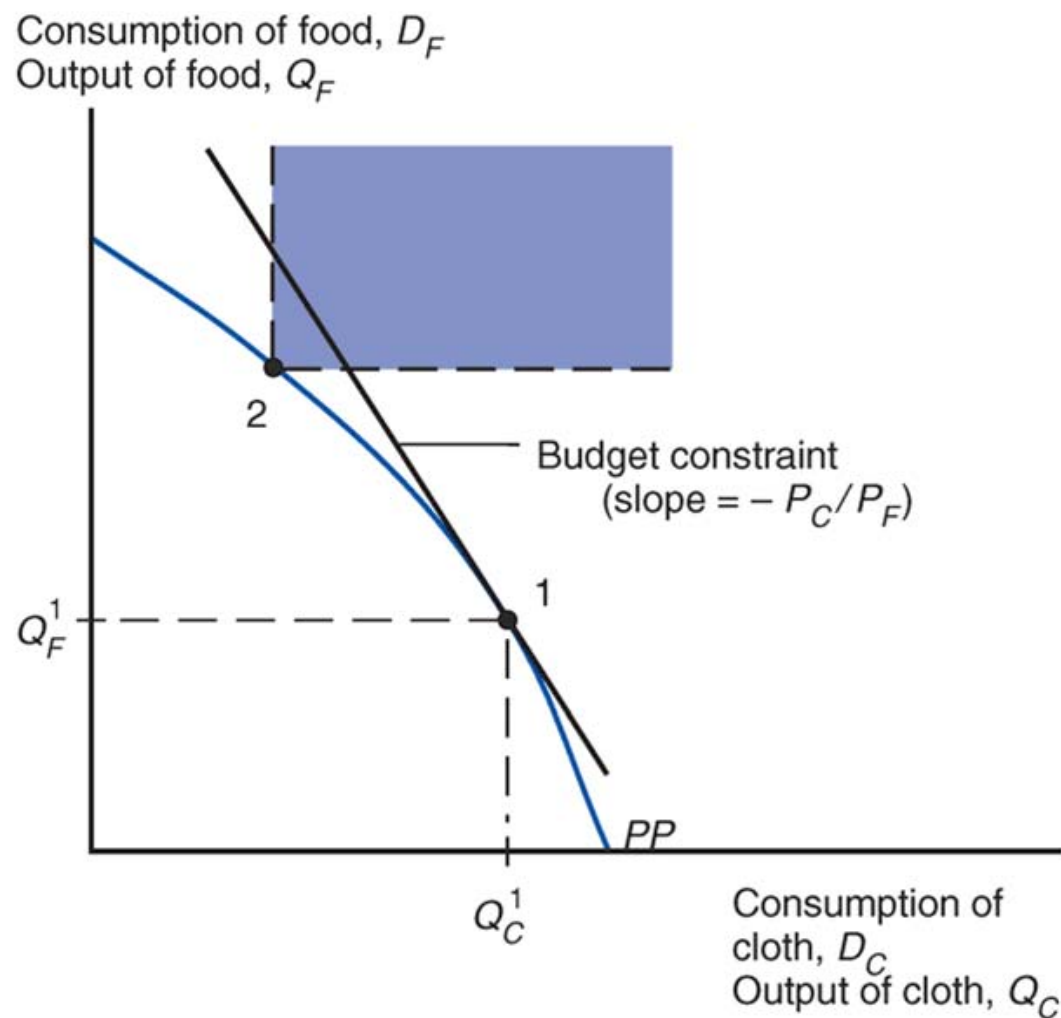
## Balanced Trade II

- ▶ The budget constraint is necessarily tangent to the PPF: a country can always afford to consume what it produces
- ▶ However, a country need not consume only the goods and services that it produces with trade
- ▶ A country can afford to consume more of both goods with trade
- ▶ This makes the country *as a whole* better off

# Fig. 4-13: Balanced Trade in Equilibrium



# Fig. 4-14: Expanded Consumption Possibilities II



# Preview

Some agents in the economy may not gain from trade

Who loses from trade?