Putting theory to work: The standard model

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- Last time: The Heckscher-Ohlin Model
  - Introduction
  - The point
  - The model
    - Setup and assumptions
    - Production possibilities
    - Production and prices
    - Autarchy equilibrium
    - Trade equilibrium
  - The big four theorems
  - The problems
    - Assumptions
    - Evidence
  - Moving forward

- Today: The Standard Model
  - Introduction
  - Model
    - Setup and assumptions
    - Production possiblities
    - Supply and Prices
    - Demand and Prices
    - Trade and Prices
  - Growth
    - Production
    - Terms of Trade
    - International effects
  - Tariffs and subsidies
  - International lending
- The location of production

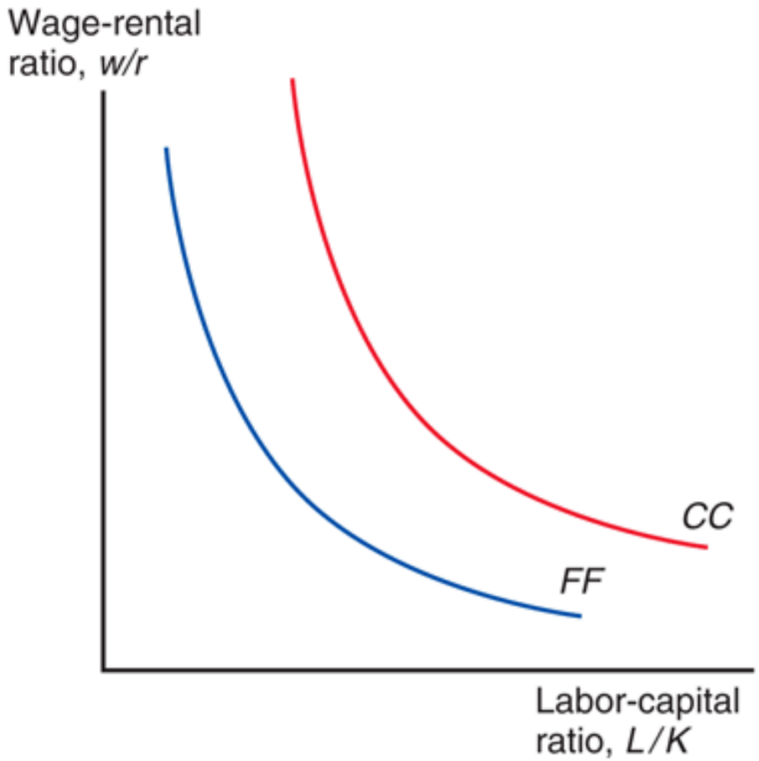
- But first a review!

Setup

- Two countries: Home (H) and Foreign (G)
- Two goods: Clothes (C) and Food (F)
- Two factors: Labor (L) and Capital (K)
- Sometimes called the 2 x 2 x 2 model

Setup

- Some terminology
  - If $\frac{L}{K} < \frac{L^*}{K^*}$, then Capital is *abundant* in Home, and Labor is *scarce*
  - If for *any* factor prices, relatively more Labor is used to make Clothes than Food, Clothes are *Labor-intensive*, and Food is *Capital-intensive*

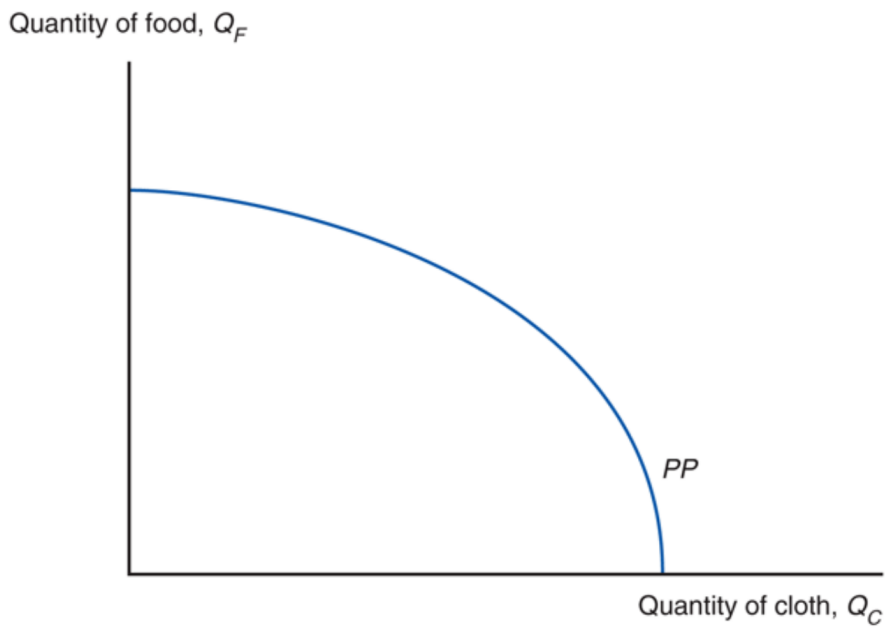


Setup

- Clothes and Food can be produced with combinations of Labor and Capital
- Both countries have the same production technology
- Production technologies are Constant Returns to Scale (double both inputs, double output)
- Each country has a different endowment of Labor and Capital
- Labor and Capital cannot move between countries, even in the long run
  - No shipping of machines allowed
  - No moving abroad
- As before, competitive firms with zero profit

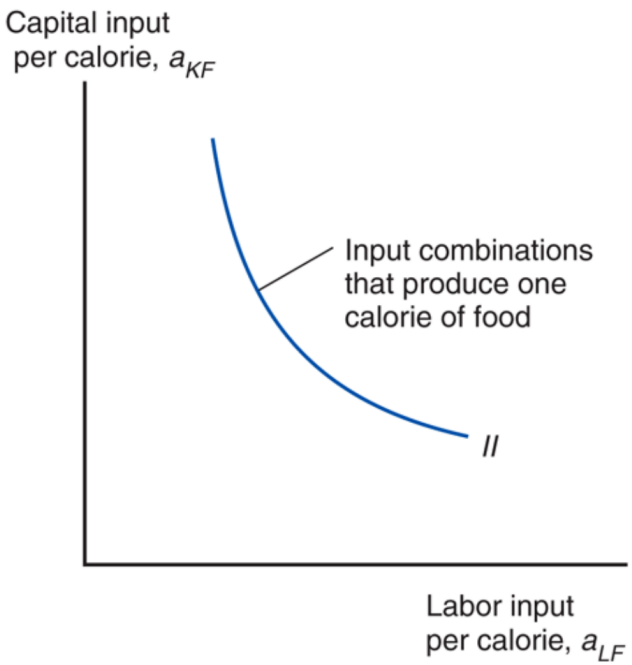
Production Possiblities Frontier

- Recall: Slope = take a bit of Labor from Food production and put it into Clothes production
- Now also: Slope = take a bit of Capital from Food production and put it into Clothes production
- In notation: Slope $= -\frac{MPL_F}{MPL_C} = -\frac{MPK_F}{MPK_C}$ (why must ratios equal?)



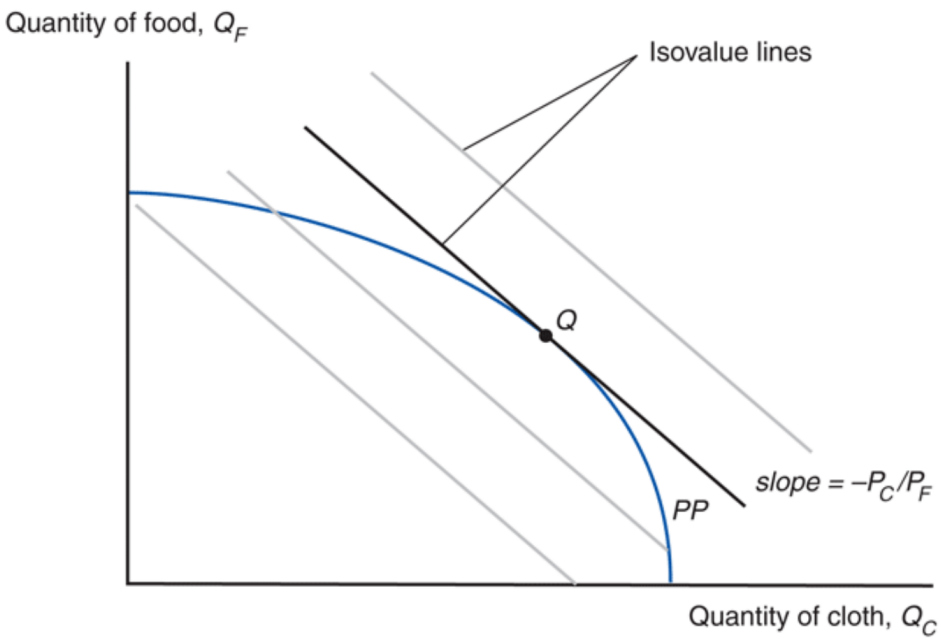
Input Possiblities

- Fix the amount of, say, Food we want to produce
- Slope = if I want to use a bit more Labor, how much Capital is freed up?
- $\frac{dQ}{dK} = MPK_F$, $\frac{dK}{dQ} = \frac{1}{MPK_F}$
- Slope $= -\frac{\frac{1}{MPK_F}}{\frac{1}{MPL_F}} = -\frac{MPL_F}{MPK_F}$
- Why is the curve convex?



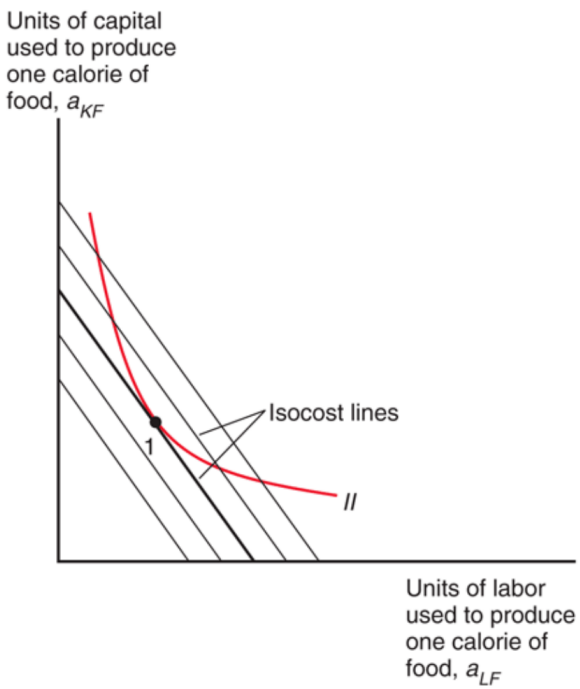
Output price ratio and production

- Suppose we have the price ratio $\frac{P_C}{P_F}$
- Then $\frac{P_C}{P_F} = \frac{MPL_F}{MPL_C} = \frac{MPK_F}{MPK_C}$ (why?)
- Production given by the point on the PPF tangent to $-\frac{P_C}{P_F}$



Input price ratio and production

- Suppose we have the price ratio $\frac{w}{r}$
- Then $\frac{w}{r} = \frac{MPL_F}{MPK_F} = \frac{MPL_C}{MPK_C}$ (why?)
- Input bundle given by the point on the input possibilities curve tangent to $-\frac{w}{r}$



Input and Output Prices

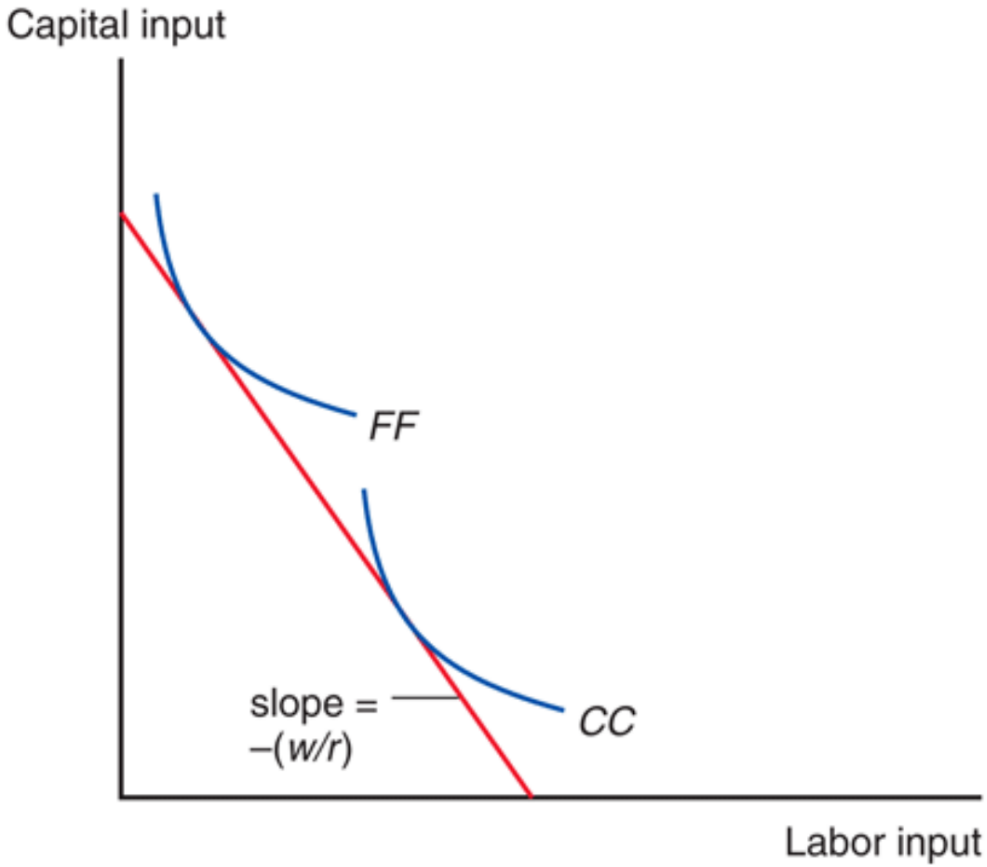
- Setup
  - Draw input possibilities curves for both goods on the same chart
  - Curves are for production of the same value of the two goods
  - Assume that both goods are produced
  - Must be line tangent to both curves, with slope wage-rental ratio
- Food industry is *labor intensive*
  - That is, for any wage-rental ratio, Food uses a higher proportion of Labor than Clothes
- Suddenly the price of food rises
  - If wage-rental ratio doesn't change, negative profits for making clothes, clothes industry closes
  - If both industries to remain open, wage-rental ratio must rise
  - Since firms hire less labor and more capital per unit produced, MPL rises and MPK falls
    - Wages rise (clothes buy more food, and wages paid in clothes rise): $\frac{w}{P_C} = MPL_C = \frac{P_F}{P_C} MPL_F$.
    - rent falls (food buys less clothes, and rent paid in food falls): $\frac{r}{P_F} = \frac{P_C}{P_F} MPK_C = MPK_F$.

The Stolper-Samuelson Theorem

- *Stolper-Samuelson*: A rise in the price of a final good for which a particular resource is more useful in production will increase the payments to that resource
- Owners of one input are always hurt by a price change in output goods.
- Trade in outputs typically changes output prices, so some people are typically hurt by trade.

Factor endowment changes and production

- If prices do not change, industry-level Labor-Capital ratios do not depend on aggregate Labor-Capital ratios



Factor endowment changes and production

- We have the accounting identity:

$$\begin{aligned}\frac{L}{K} &= \frac{L_C}{K} + \frac{L_F}{K} \\ &= \frac{L_C}{K_C}\frac{K_C}{K} + \frac{L_F}{K_F}\frac{K_F}{K}\end{aligned}$$

- Changes in aggregate $\frac{L}{K}$ do not affect $\frac{L_C}{K_C}$ and $\frac{L_F}{K_F}$
- If $\frac{L}{K}$ increases, only way for the identity to hold is for Capital to move from the capital intensive industry to the labor intensive industry
- If Capital moves, since industry Capital-Labor ratios don't change, Labor must move as well
- That is, $\frac{L}{K}$ increases $\rightarrow$ more Labor-intensive good, less Capital-intensive good

The Rybczynski Theorem

- *Rybczynski*: If country gets more of a factor, then the output of the good that uses that factor intensively will rise while the output of the other good will fall.

Trade Patterns

- Remember: Countries are identical, except for relative factor endowments
- Assume that home has relatively more Capital: $\frac{L}{K} < \frac{L^*}{K^*}$
- For *any* output price, Rybczynski $\rightarrow$ relatively more Capital intensive good (Clothing) produced at home:

$$\frac{Q_C}{Q_F} > \frac{Q_C^*}{Q_F^*}$$

- Since consumption depends only on output price, equilibrium consumption ratio $\frac{D_C}{D_F} = \frac{D_C^*}{D_F^*}$
- (Hidden assumption: homotheticity again!)
- Must be that home exports Capital-intensive good (Clothes) and imports Labor-intensive good (Food)

The Hecksher-Ohlin Theorem

- The country with relatively more Capital exports the Capital-intensive good.
- The country with relatively more Labor exports the Labor-intensive good.
- *Heckscher-Ohlin*: Countries with relatively more of a resource will export goods for which that resource is more useful in production

The effect of trade on world factor prices

- In our proof of Stolper-Samuelson, we saw a graph as below showing how factor prices are determined in equilibrium
- This graph is related only to the technology available and relative price of the two goods
- This graph is *not* related to aggregate factor endowments $\frac{L}{K}$ and $\frac{L^*}{K^*}$
- Since in trade relative prices are the same, and technologies in the countries are the same:
  - So are factor prices the same in the two countries!
- Intuition: Exporting the Labor-intensive good is like exporting Labor, even though Labor cannot move between countries

The Four Theorems

- Famous implications are the four theorems:
  1. *Heckscher-Ohlin*: Countries abundent in a factor will export the good intensive in that factor
  2. *Rybczynski*: If a country's relative amount of a factor rises, then the output of the good intensive in that factor will rise while the output of the other good will fall.
  3. *Stolper-Samuelson*: A rise in the relative price of an output intensive in a factor will increase thereal returns to that factor, and decrease returns to the other factor
  4. *Factor-price equalization*: Trade causes factor prices to completely converge
- Empirical tests will be based on these four predictions

Problems - assumptions

1. Proofs of the theorems require that both goods are produced in both countries
2. The model assumes technology is the same everywhere
3. The model assumes that Capital cannot move
4. Output goods have the same price everywhere

- In the early 20th century, these assumptions were reasonable
- Now they seem like a poor approximation to the world

Factor price equalization

- Most obvious test
- Most obvious failure, even as an approximation

Country	Hourly Compensation of Production Workers, 2011
United States	100
Germany	133
Japan	101
Spain	80
South Korea	53
Brazil	33
Mexico	18
China*	4

*2008

Source: Bureau of Labor Statistics, *Foreign Labor Statistics Home Page.*

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Summary

- Heckscher-Ohlin Theory exteremly important in the history of economic thought on trade
- Point: Trade has long-run effects on the distribution of income
- Main predictions relate to the four theorems
  1. Heckscher-Ohlin
  2. Rybczynski
  3. Stolper-Samuelson
  4. Factor Price Equalization
- In the last 20 years, theory has become less popular as it has failed to match trade data, even as an approximation

- End review!

Chapter 6: The standard model

- Best chapter yet
  - Probably a Krugman chapter
  - Lots of intuition, simple model, important questions
- Why do countries trade?
  - Differences in technology?
  - Differences in factor endowments?
- We just need different production possibilities
- For much analysis *it doesn't matter!*

Laying out the model

- Environment
- Supply and Prices
- Demand, Welfare, and Prices
- Equilibrium

Environment

- Two countries: Home (H), Foreign (G)
- Two goods: Food (F), Clothes (C)
- We aren't going to specify the factors
  - Ricardo: Labor
  - Specific Factors: Land, Capital, Labor
  - Heckscher Ohlin: Capital, Labor
- We aren't going to specify exact technology for converting factors into goods
  - Ricardo: Unit Labor requirement
  - Specific Factors: $Q_C(K, L), Q_F(T, L)$
  - Heckscher Ohlin: $Q_C(K, L), Q_F(K, L)$

Supply

- Each country is going to be given a production possibilities frontier
- We don't ask where it came from
- Book: Economy will produce at point on PPF which maximizes value
- This result makes sense for a dictator (or social planner)
- Will the market deliver that result?

Supply

- We know:
  1. Full employment of factors (and positive marginal product) means production on the PPF
  2. We have argued that slope of PPF is the negative ratio of marginal products
  3. From wages/rental, in equlibrium: $\frac{P_F}{P_C} = \frac{MPL_C}{MPL_F}$
- Therefore: a line with negative slope of prices will be tangent to the PPF at the point of production
- But what about the value of production?

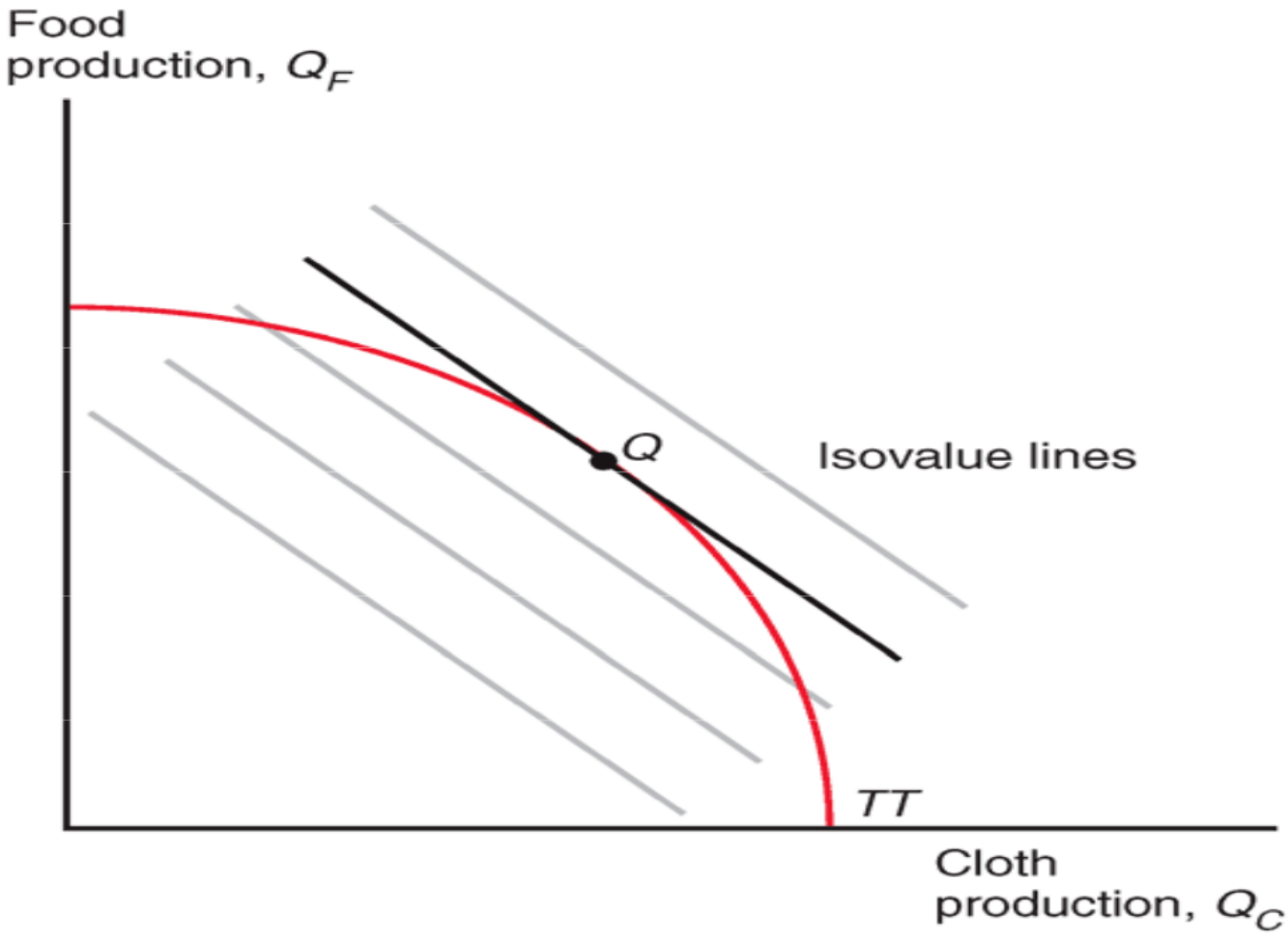
The isovalue lines

- What is the equation for the price line tangent to the PPF?

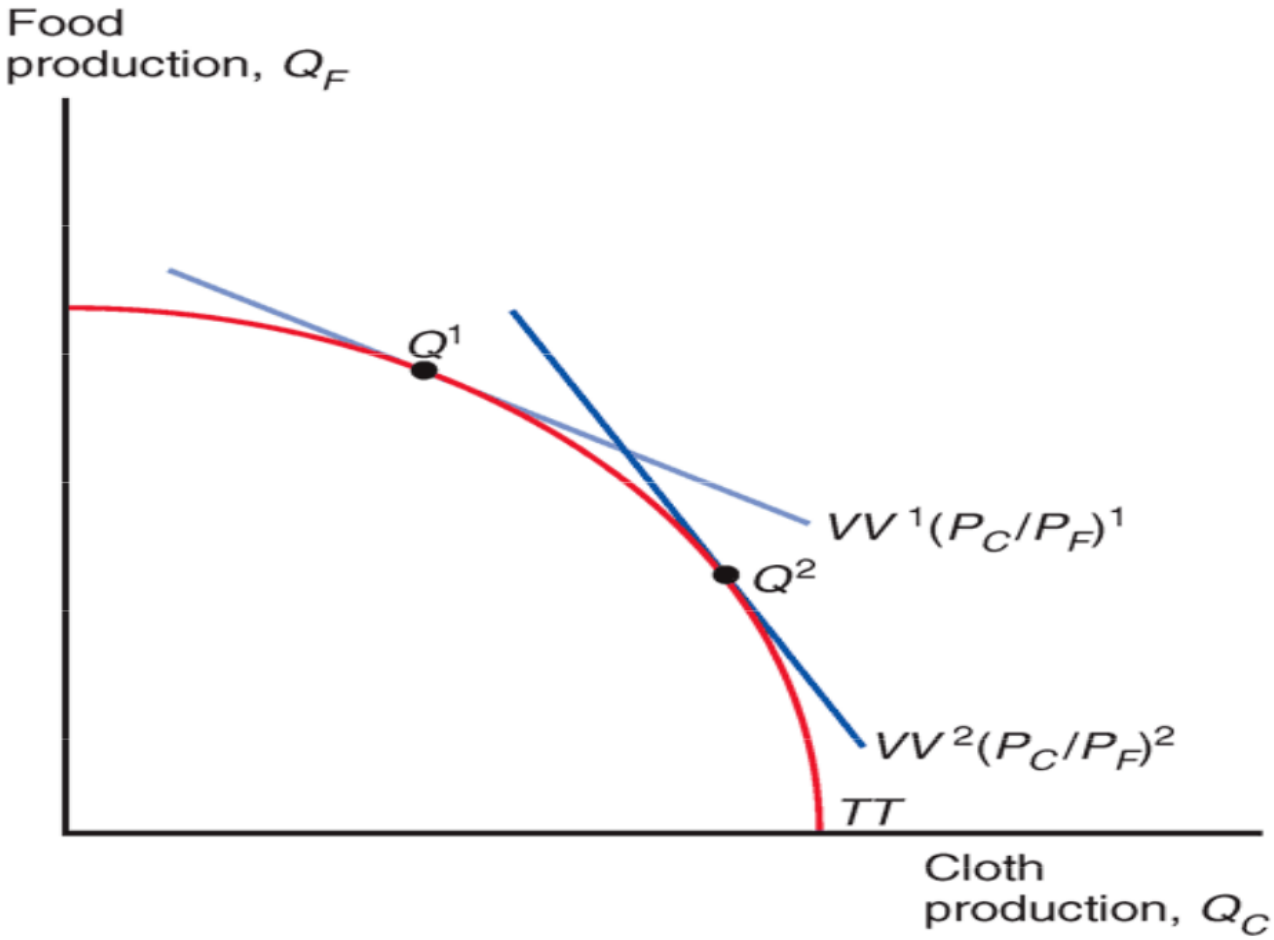
Supply

- We have shown that equilibrium production is at a point where production value is maximized
- Follows from the equilibrium wage and rental equations, and therefore the no-profit condition

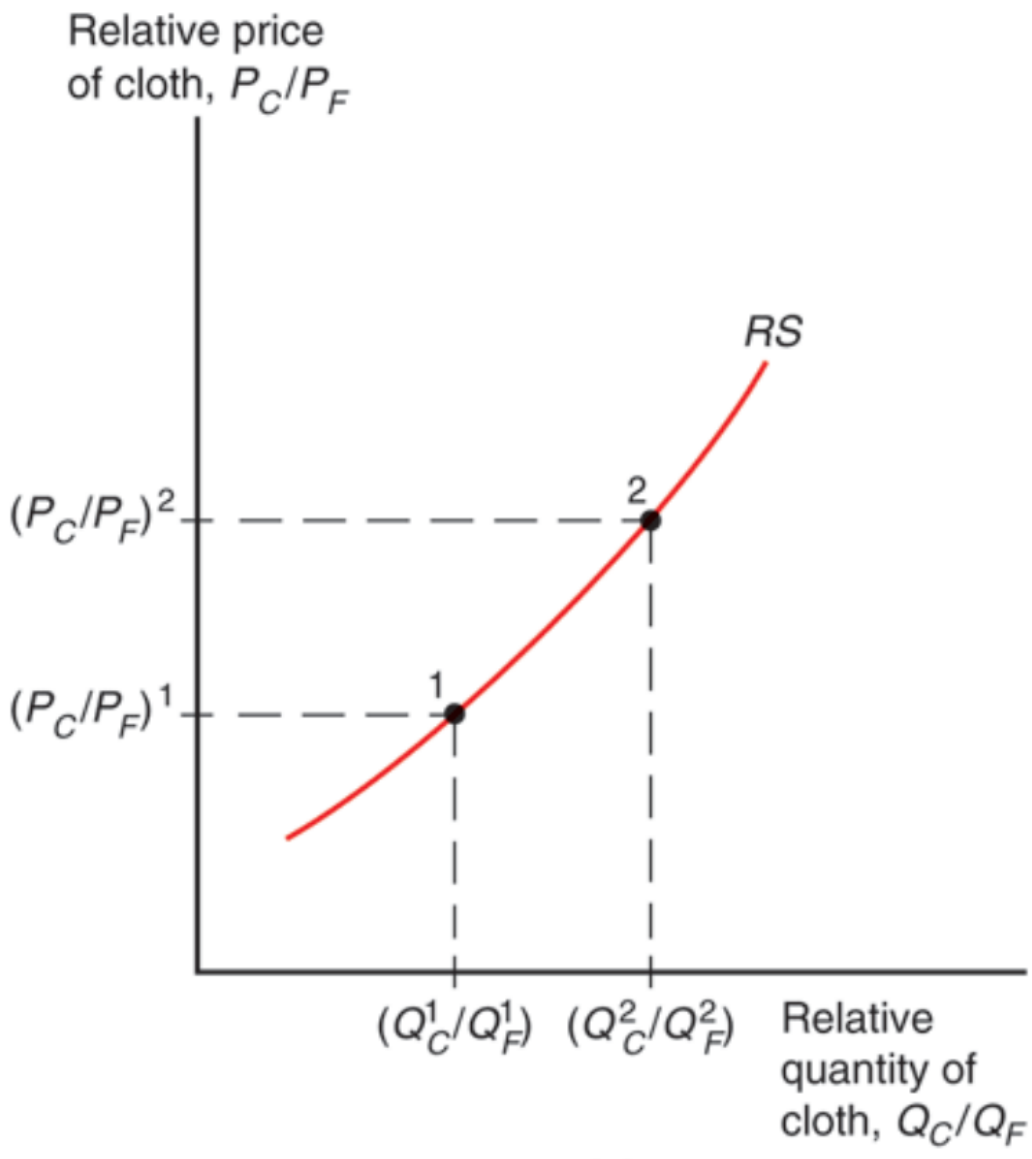
Supply



Supply


Food
production, Q_F
Q^1
$VV^1(P_C/P_F)^1$
Q^2
$VV^2(P_C/P_F)^2$
TT
Cloth
production, Q_C

Supply


Relative price of cloth, P_C/P_F
RS
$(P_C/P_F)^2$
$(P_C/P_F)^1$
2
1
(Q_C^1/Q_F^1)
(Q_C^2/Q_F^2)
Relative quantity of cloth, Q_C/Q_F

Demand

- Until this class, demand has just been a curve
- (ok, in a homework I made you plot a couple of them)
- Today we want to analyze welfare
- We need to go a bit farther
- In short – today we skimp on the supply, but say more about demand

Demand

- We have just seen that the value produced is $P_C Q_C + P_F Q_F$.
- Trade balance says that the value of consumption must equal value of production:

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

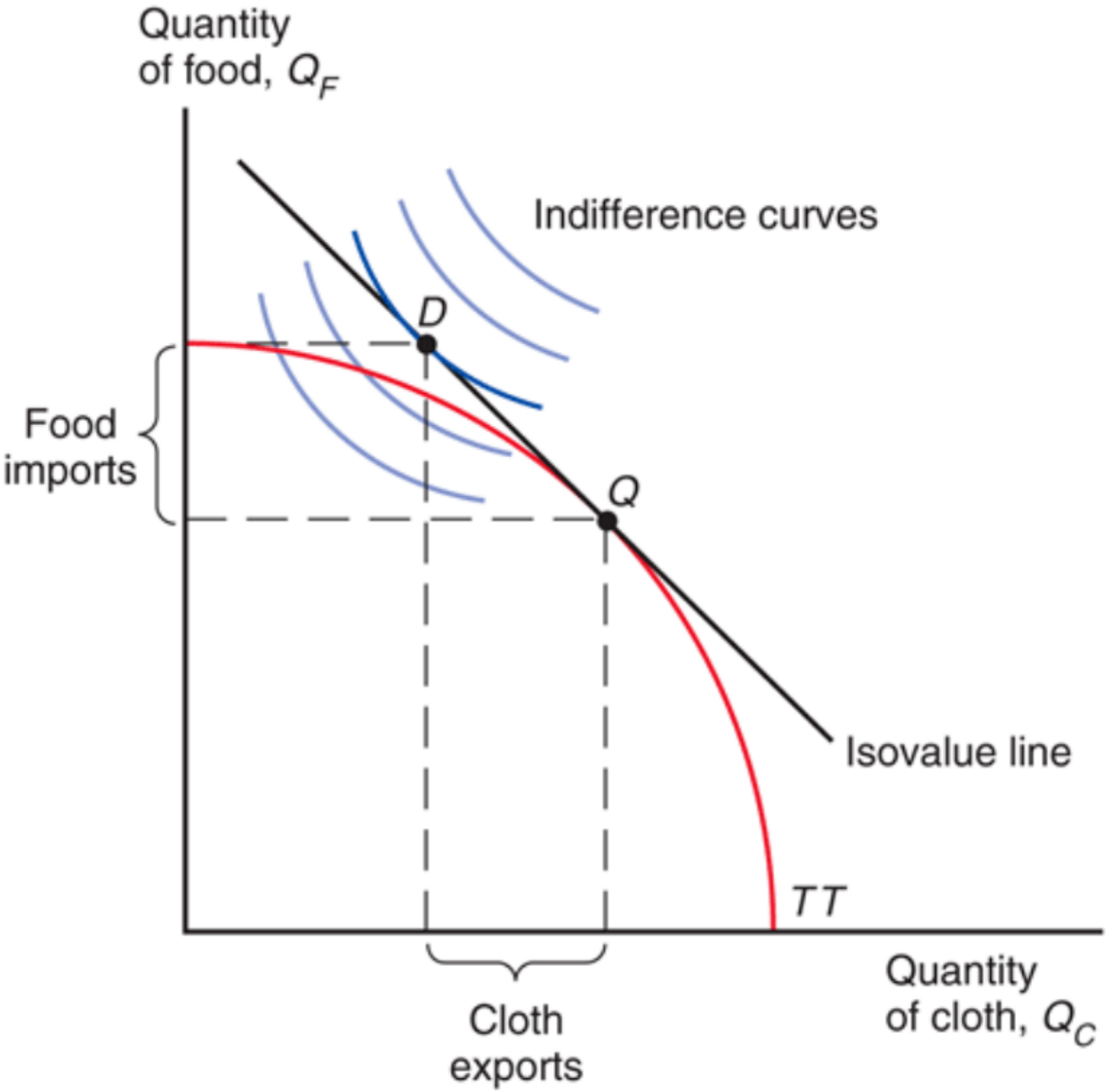
- What does this imply about the location of consumption on our PPF when trading?
- What additional condition do we have in autarchy?

The indifference curve

- The set of bundles of goods over which the consumer is indifferent
  - More of either good is better
  - Slope at any point in $(-\infty, 0]$, that is, must compensate
  - If I have little of one good, you have to give me a lot of the other to compensate for further reduction. (decreasing marginal utility)
- Results in convex curves emanating from the origin

Demand

- Where would autarchy consumption be?

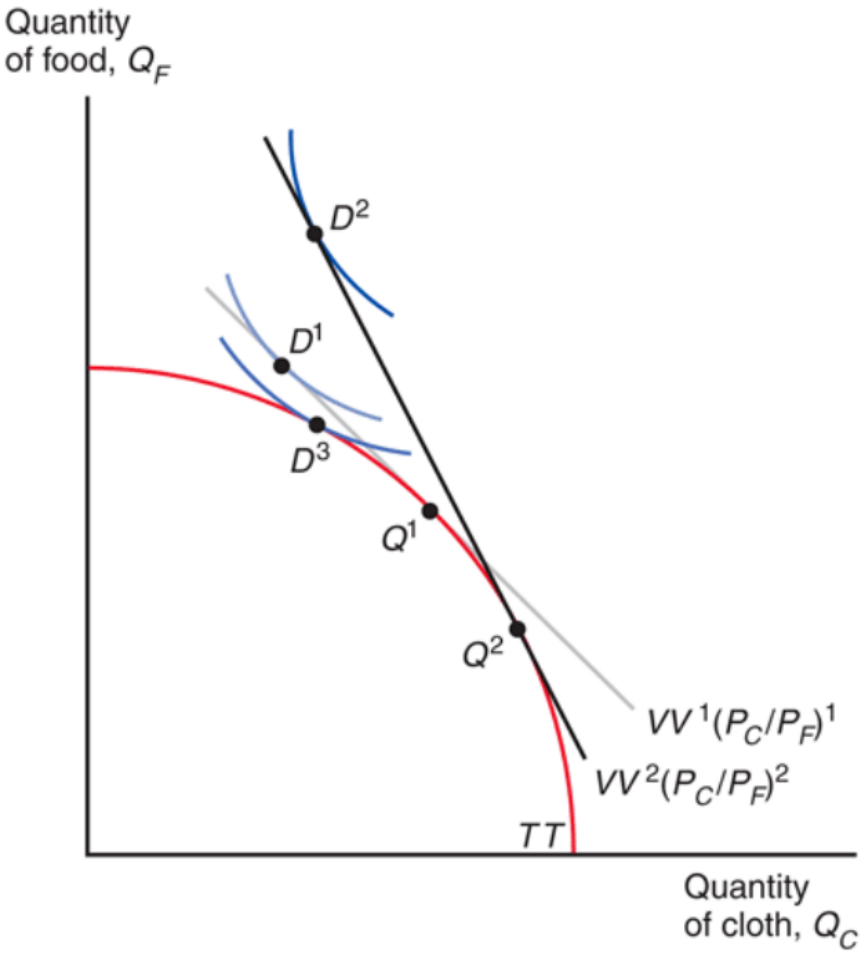


Price changes and welfare

- Suppose my country sells clothes to buy food
- If the relative price of clothes goes up:
  - I become richer – Foreign has to give me more food for my clothes (*income effect*)
  - I change my consumption bundle to relatively more food (*income effect*)
  - What happens to production at Home?
  - What happens to production at Foreign?

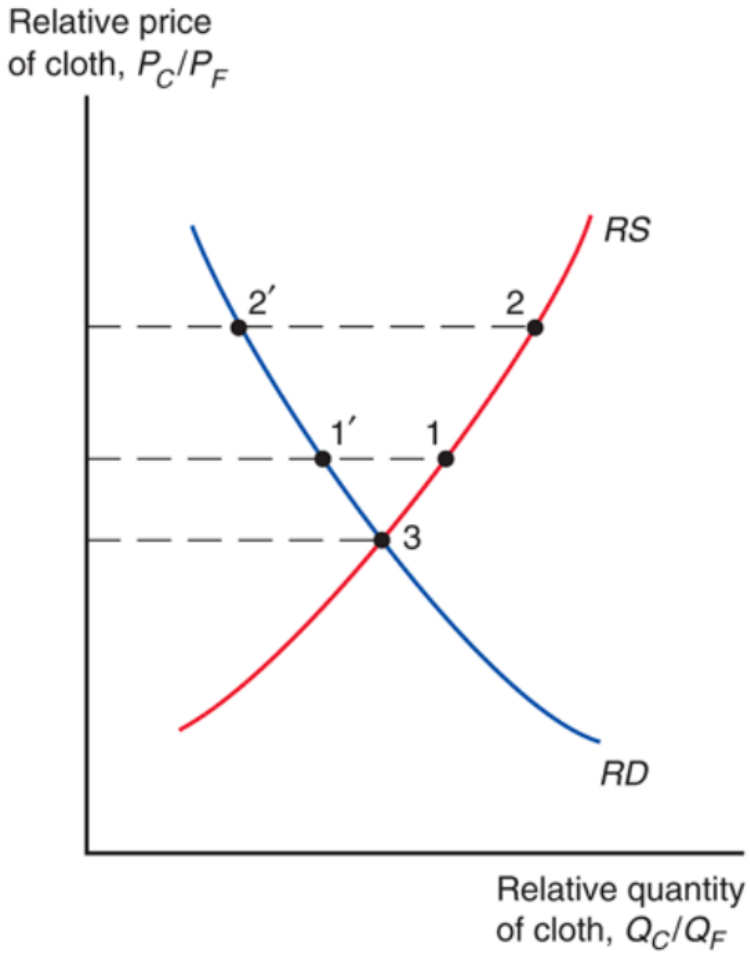
Price changes and welfare

- See income and substitution effects in chart



(a) Production and Consumption

Price changes and welfare



(b) Relative Supply and Demand

- Which good does Home export?

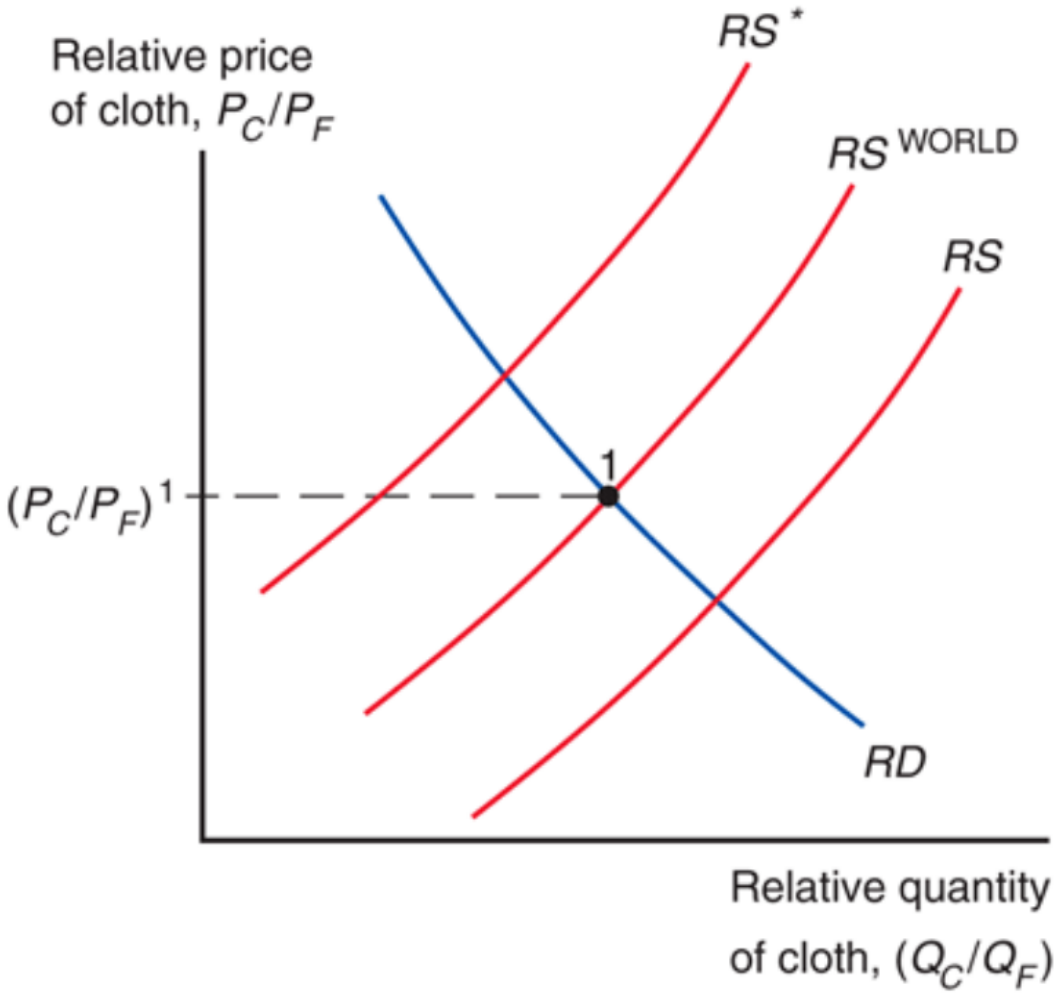
Price changes and welfare

- How would Home consumption change if the relative price of Clothes fell?

Price changes and welfare

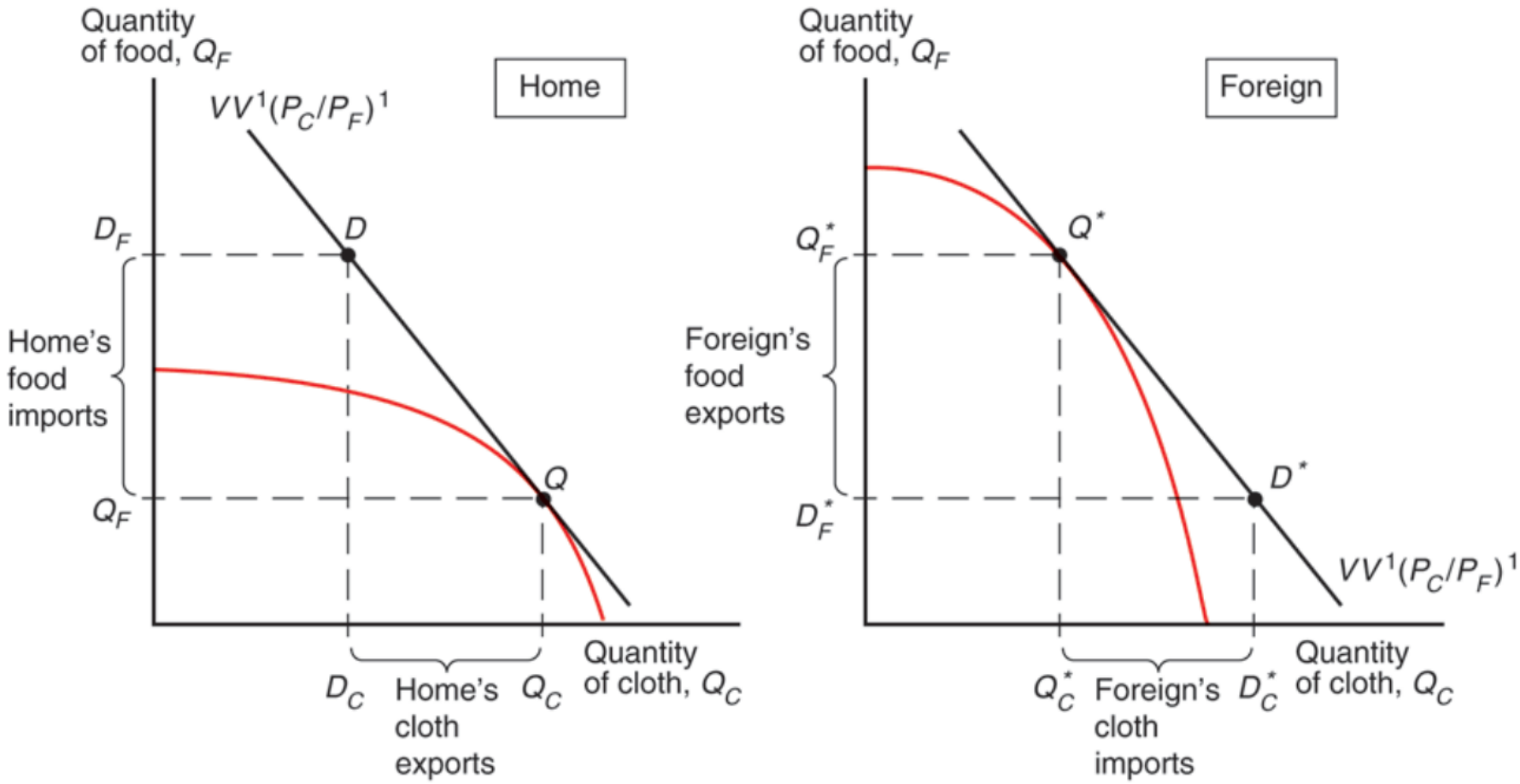
- *Terms of trade*
- Defined as the price of the exported good divided by the price of the imported good
- Welfare increases if terms of trade rise (or improve)
- Welfare decreases if terms of trade fall (or worsen)
- A worsening of the terms of trade can never make welfare fall below autarchy level (why?)

Equilibrium Trade



- Are RS and RS^* the autarchy supplies?

Equilibrium Trade



- What is wrong with these pictures (under the assumptions we have typically been making?)

End model development

- We have now presented the model
- Simpler than the others we developed
- Countries have PPFs
- Countries have demand
- Prices affect both production and consumption
- Improvement in terms of trade helps
- Worsening of terms of trade hurts

Some analysis

- Is growth in other countries good or bad for us?
- If other countries will not respond, should we impose tariffs?
- How will Danish current account surplus affect future Danish consumption?

Growth

- Question 1: Is China's growth good for Denmark?
- Question 2: Is Danish growth better or worse thanks to international trade?

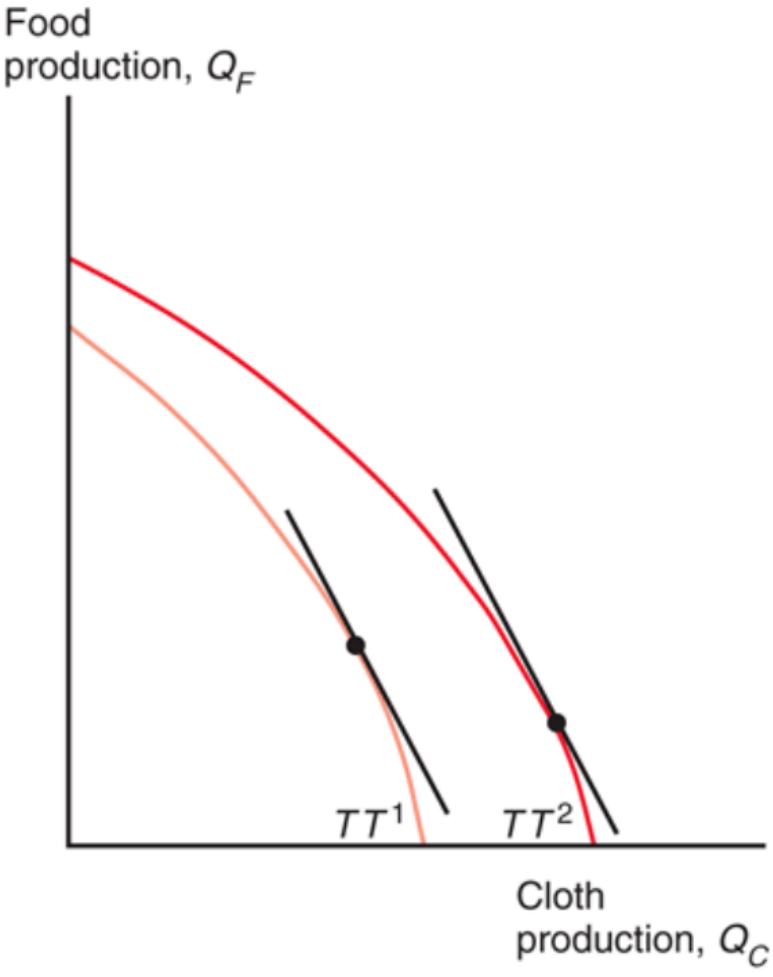
Growth

- Claim in book (pg. 158):
  The international trade effects of growth result from the fact that such growth typically has a bias.
- I suspect that unbiased growth still affects trade
- come back to this point

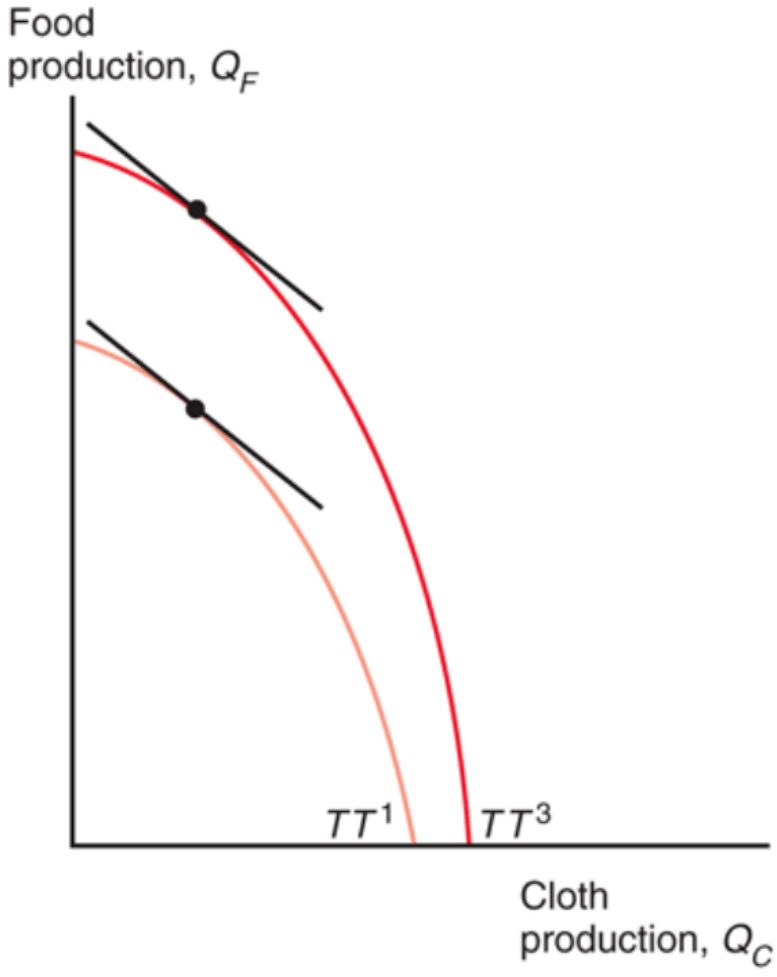
Biased growth

- Growth that expands the production possibilities more towards one good
- Growth that, for any fixed price, always causes relatively more of one good to be produced

Biased growth



(a) Growth biased toward cloth

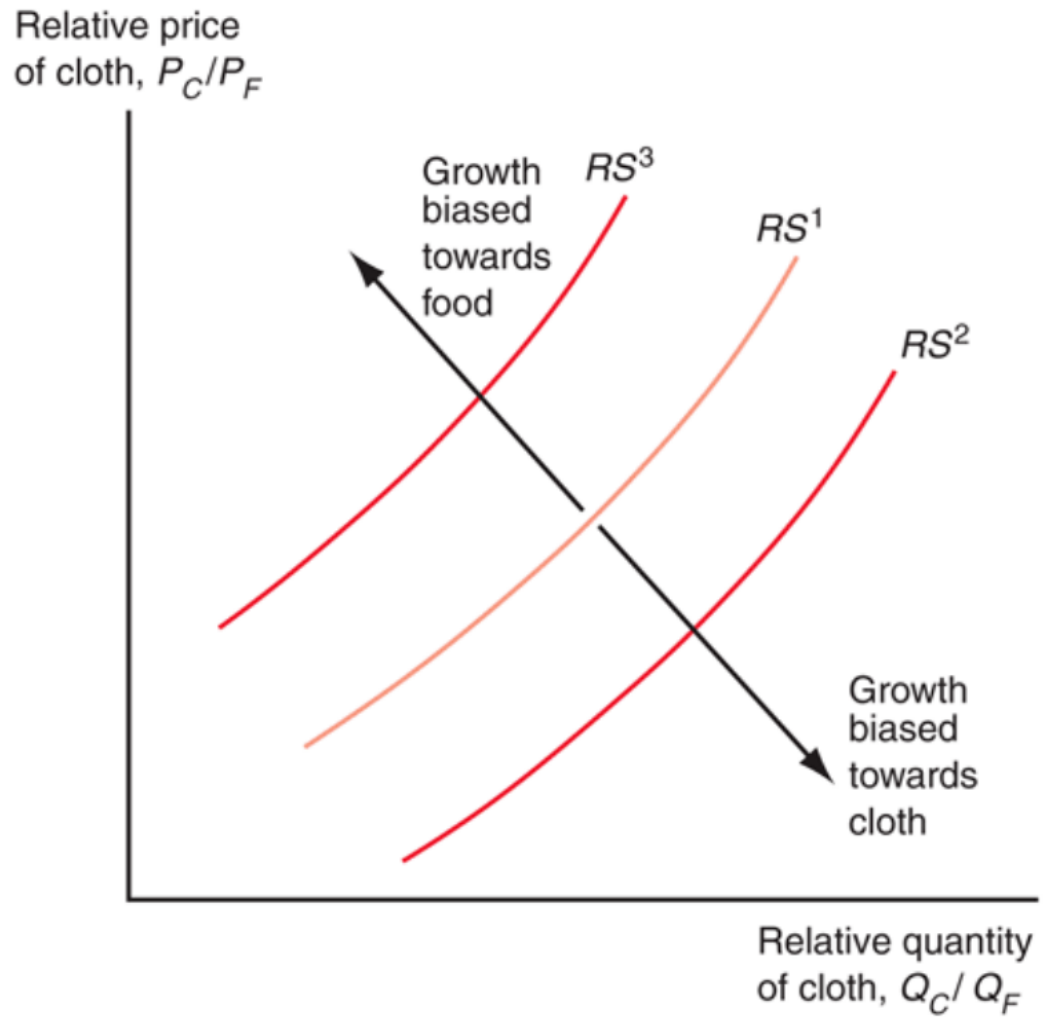


(b) Growth biased toward food

Biased growth

- Suppose equilibrium trade prices didn't change
- Foreign supplies same good mix
- Home supplies relatively more of one good
- This will affect the world relative supply

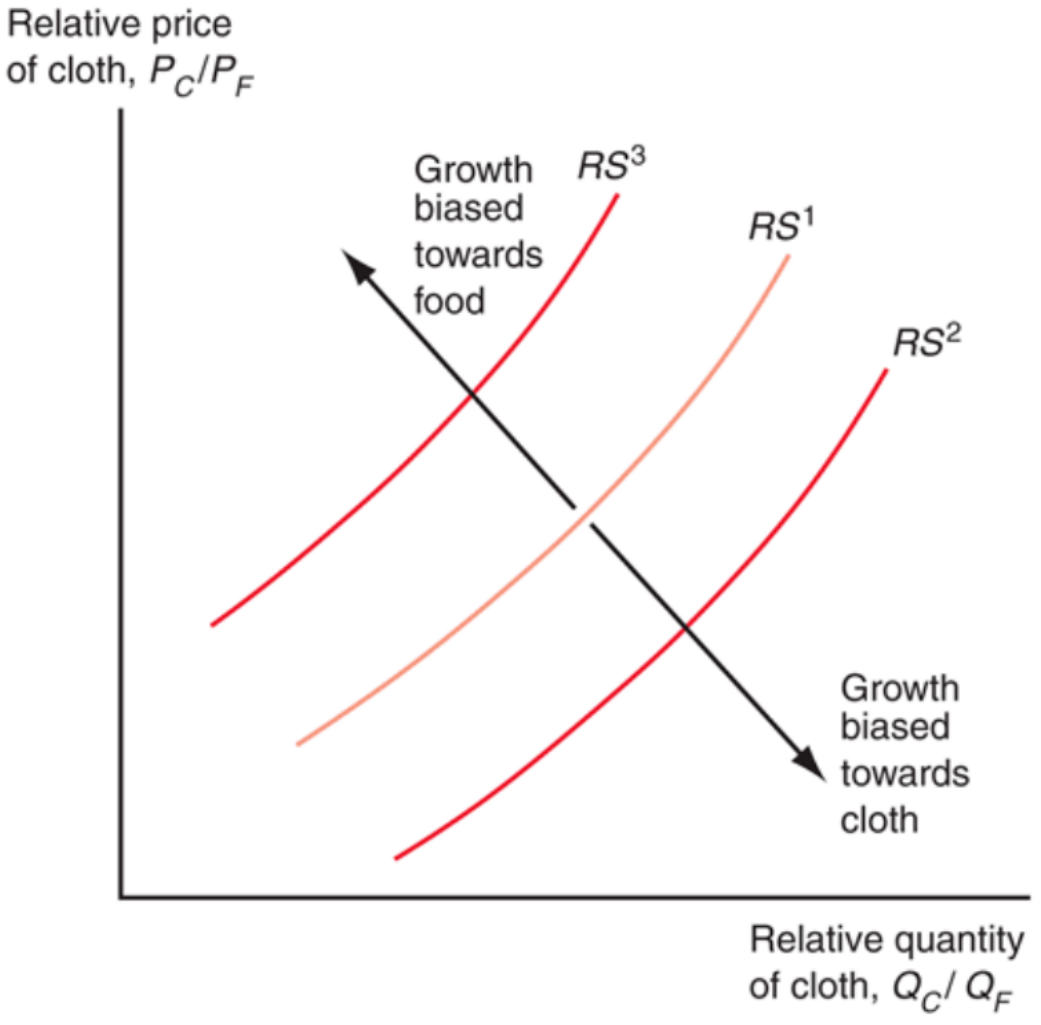
Biased growth



(c) Effects of biased growth on relative supply

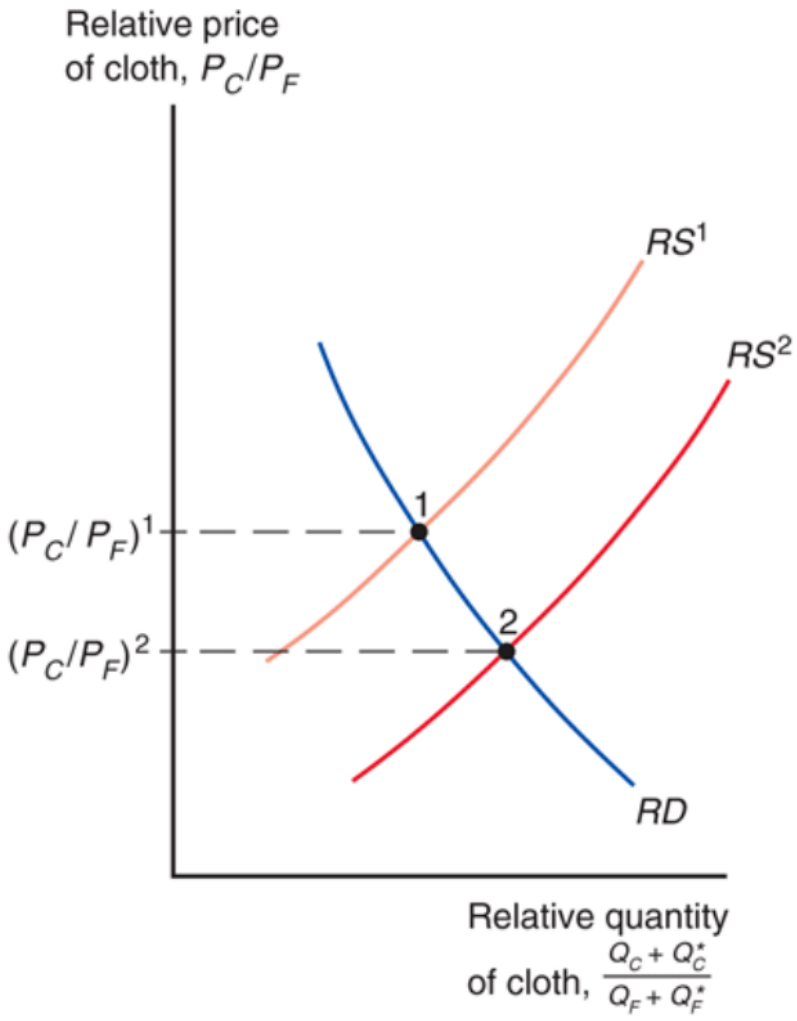
Biased growth

- Of course, going to affect equilibrium price



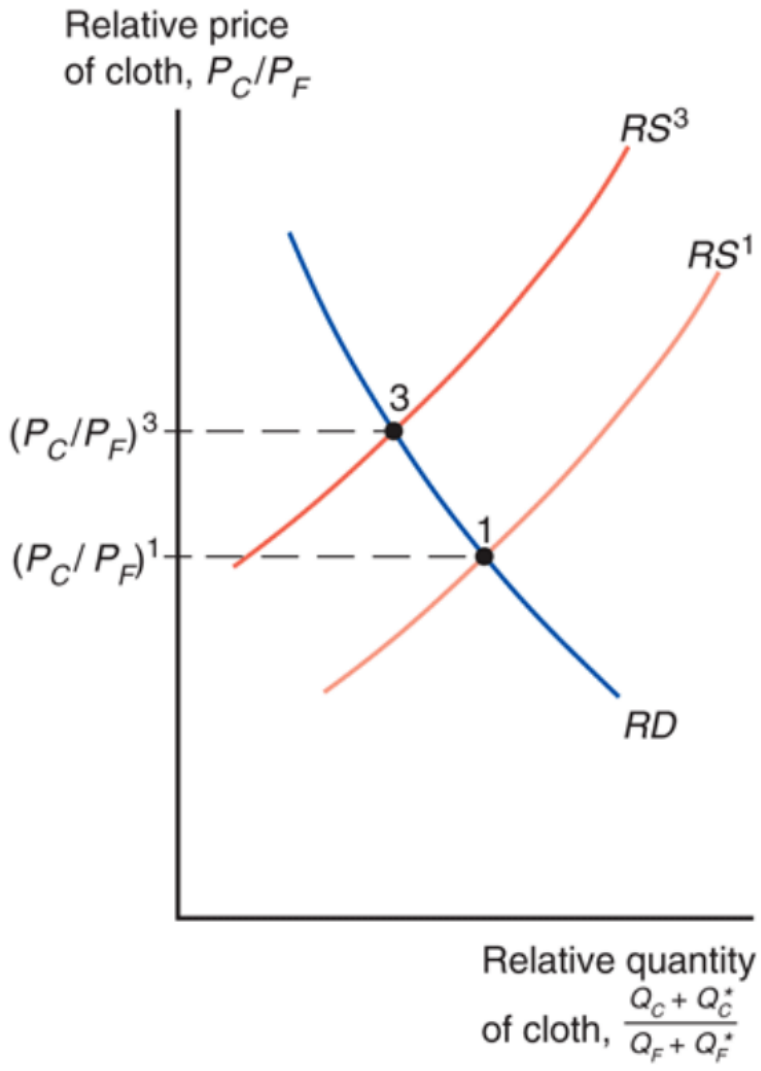
(c) Effects of biased growth on relative supply

Biased growth



(a) Cloth-biased growth

Biased growth



(b) Food-biased growth

Biased growth

- Effect on price depends upon which good gets the biased growth
- Effect on price does not depend upon which country grows
- If Home exports cloth, does growth in Foreign in Food help or hurt Home? Why?

Biased growth

- Export-biased growth is bad for terms of trade
- Import-biased growth is good for terms of trade

Biased growth

- Columbia Economist Jagdish Baghwati showed as a graduate student that growth at home can actually reduce welfare
- But productivity growth usually increases income, even if it worsens terms of trade
- Growth of other countries in Home's export industry does not increase income

Unbiased Growth

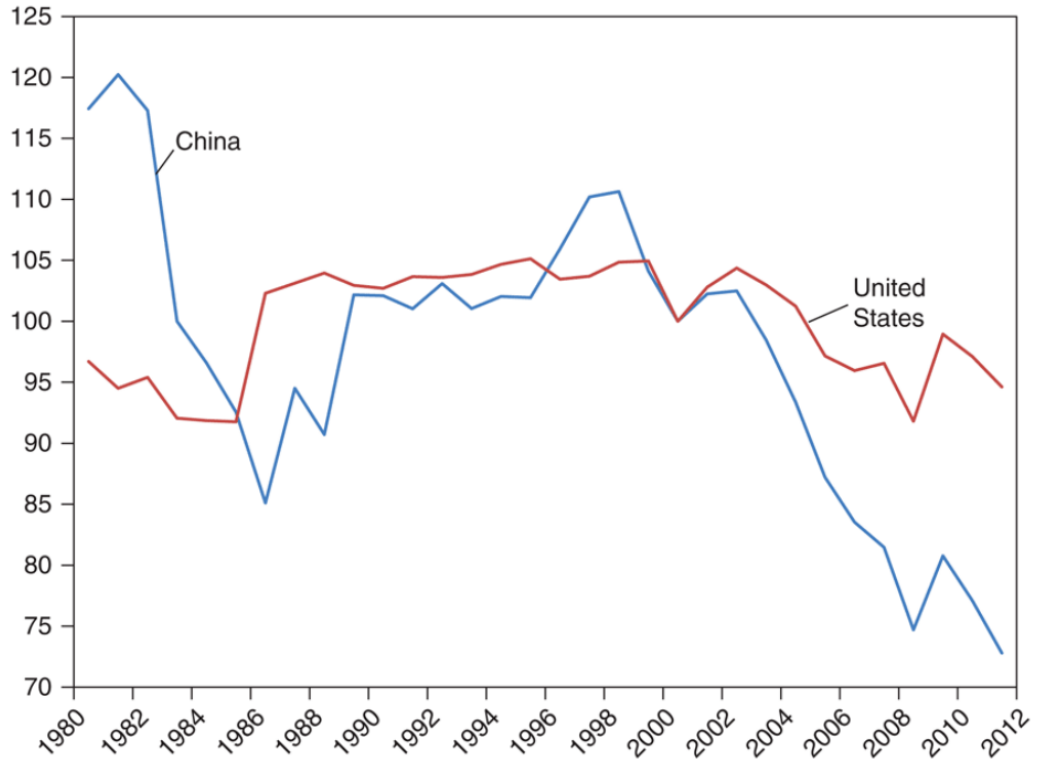
- I think it also affects trade and production
- Effect similar to export-orientated biased growth (bad)

Case study from book

- Should we expect growth in developing countries to hurt developed world consumers?
- Depends in which industry their growth happens
- Case: Chinese productivity growth in manufacturing – China's export industry

Case study from book

- China-US terms of trade



Source: World Development Indicators, World Bank.

- What the book isn't saying...

Tariffs and Export Subsidies

- What are they?
  - *Tariffs* are taxes levied on imports
  - *Export subsidies* are payments given to domestic producers who sell abroad
- Scope - effect on terms of trade
  - Tariffs are not usually motivated by terms of trade
  - They do have terms of trade effects
- Questions
  - Do tariffs help or hurt Home consumers?
  - Do export subsidies help or hurt Home consumers?

Tariffs

- Tariffs are a tax applied in some places, not others
- Different relative prices faced by people in different countries
- We defined terms of trade as export good pr. / import good pr.
- But now we have two sets of rel. prices – *internal* and *external*

Tariffs

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- Different relative prices faced by people in different countries
- We defined terms of trade as export good pr. / import good pr.
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Tariffs

- We are going to call *external* prices the terms of trade
  - External prices govern the value of Home's exports in terms of Foreign's exports
  - Internal prices govern the choices of production and consumption at Home
- Suppose Home puts a tariff on Food
- Suppose external prices do not change
  - What happends to production of Food at home?
  - What happends to consumption of Food at home?
  - If Food were Labor-intensive, which factor benefits?

Tariffs

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- Suppose external prices do not change
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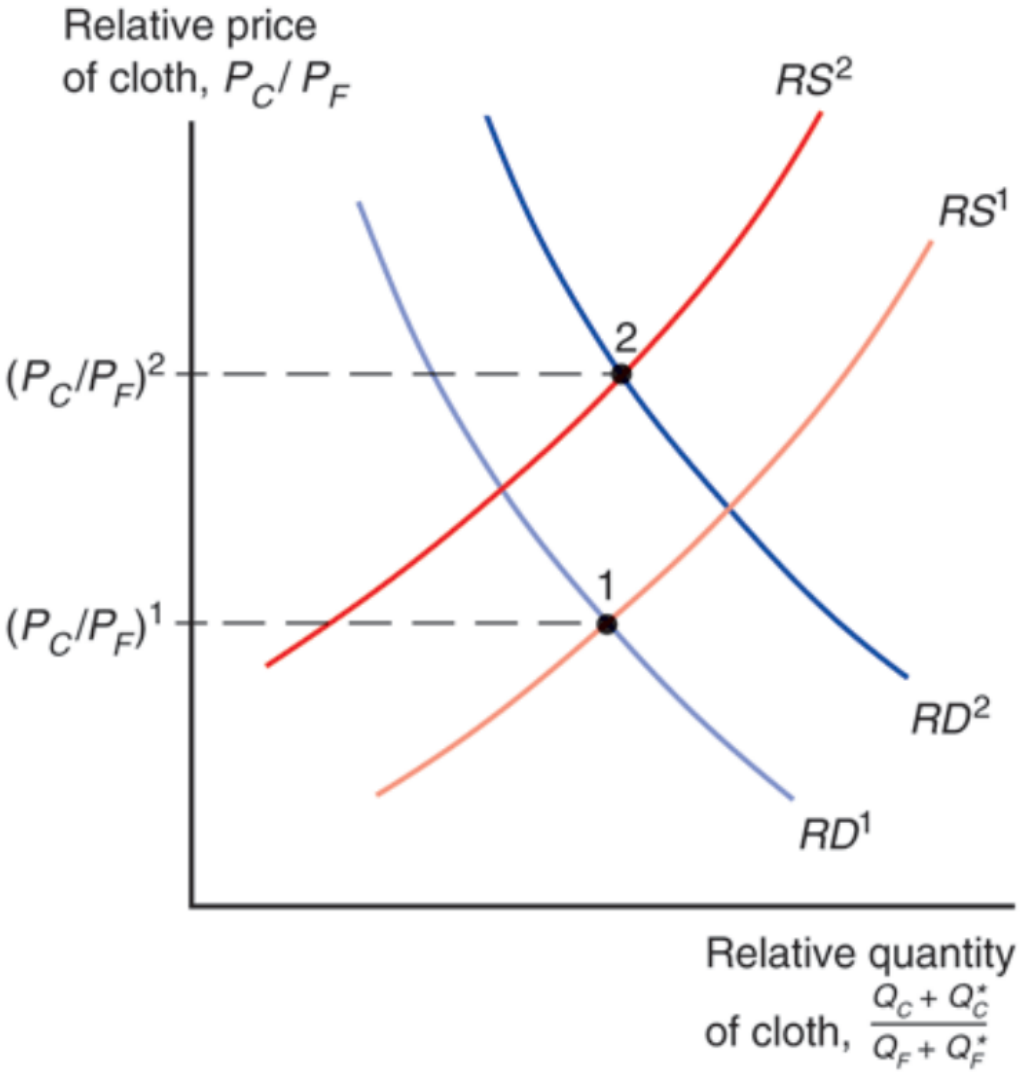
  - If Food were Labor-intensive, which factor benefits?

External Price (TOT) Effect of Home Tariff on Food

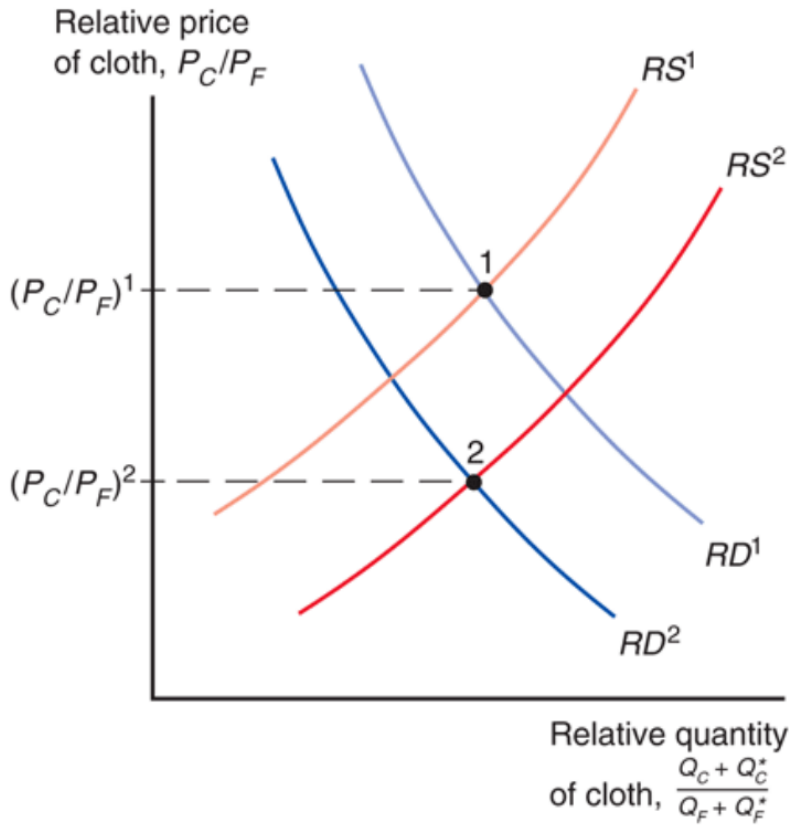


External Price (TOT) Effect of Home Tariff on Food

- Terms of Trade for Home improved
- Now Home can afford more Food for the same production of Clothes
- Great, right! But wait, let's think about this again
- Domestically, a Tariff is initially like a worsening of terms of trade!
- We need the External Price TOT Effect to dominate
- There is an optimal tariff
  - Typically small for small countries, large for large countries. Why?
  - Talk more about this in a later chapter

Export subsidy

- In a similar fashion, will reduce external TOT
- Domestically, however, will increase the internal price of the export good



Trade Policy Discussion

- Export subsidy and tariff seem very similar
- That is because we are missing something really important

Trade Policy Discussion

- Financing!
  - Tariffs are financed by Foreign
  - Export Subsidies are financed by Home

Trade Policy Discussion

- Is it good for Denmark if China subsidizes its exports?
- The (Stiglitz, I think) new car example
- Good for who again?

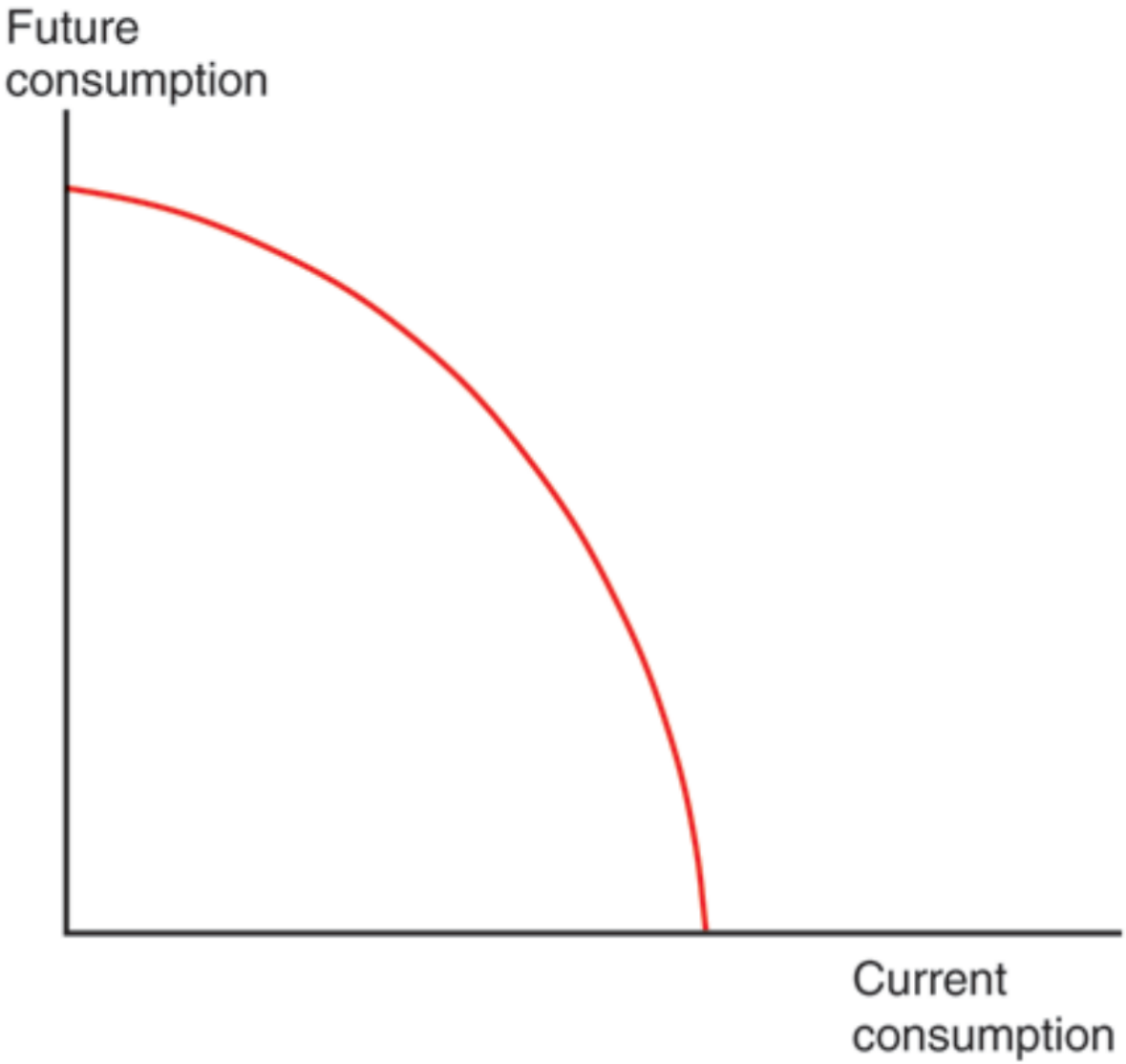
Intertemporal Trade

- Dipping into 2nd half of the course – International Finance
- Why? Because analysis is similar to current model
- Setup:
  - Two countries: Home (H), Foreign (G)
  - Two goods: Cheese today, and Cheese tomorrow
  - Countries have different technology for converting today Cheese into tomorrow Cheese.
  - Maybe only Home has refrigerators

Intertemporal Trade

- More serious motivation:
  - One country might have better investment opportunities
  - One country may have found oil, but it will run out tomorrow

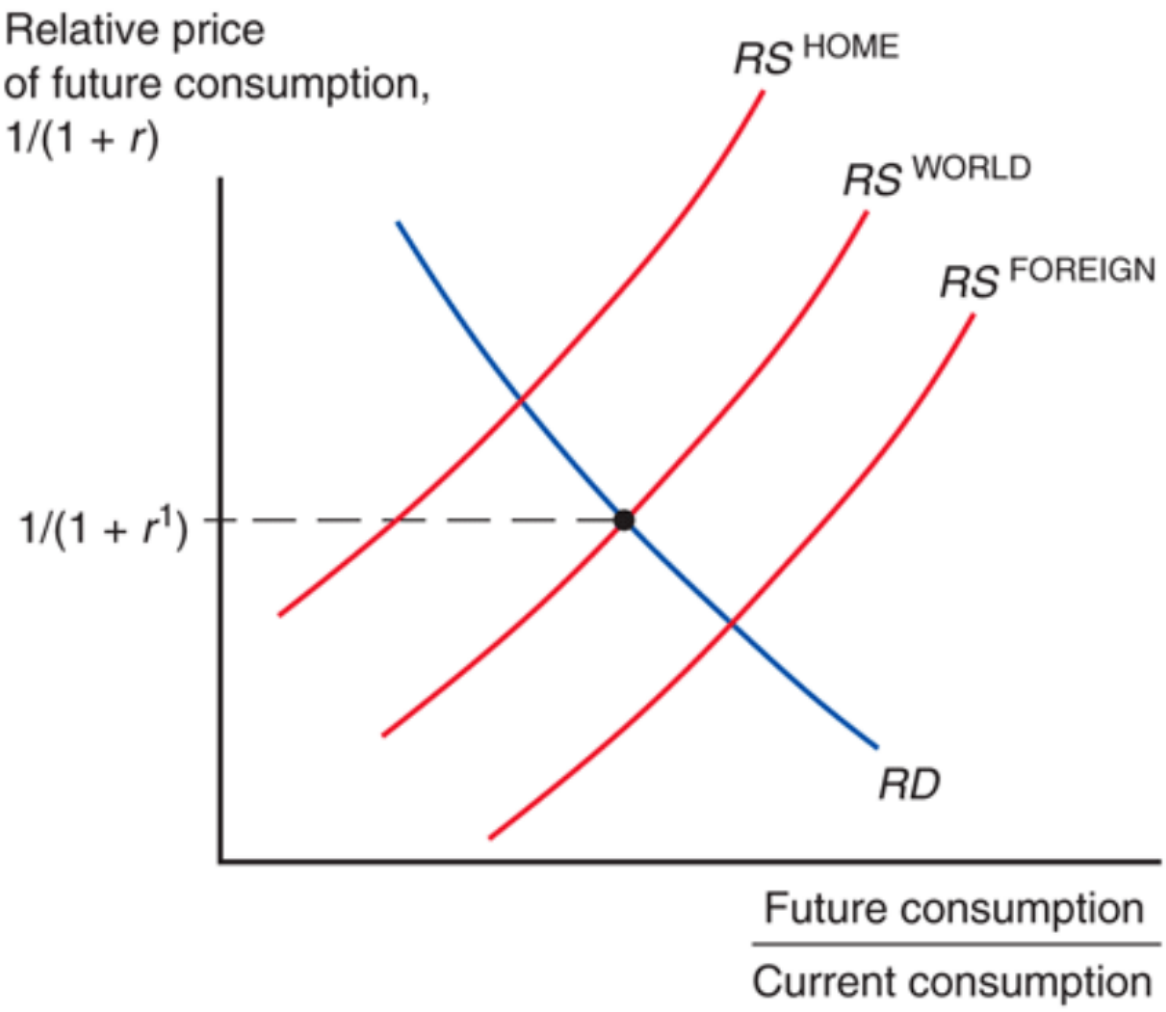
Intertemporal PPF



Price of Future Consumption

- Just like bank loan, you have to pay for current consumption
- Suppose that you have to pay $1 + r$ units of future cheese for one unit of current cheese
- How much current cheese to I have to give up for one unit of future cheese?
- That is the relative price of future cheese in terms of current cheese

Intertemporal Cheese equilibrium



- Summary
  - We set up the model
    - More on demand
    - Less on supply
  - Growth
  - Tariffs and export subsidies
  - International cheese lending

- Next time:
  - The location of production
    - One of the things Krugman won Nobel for
    - Getting behind on the syllabus (I'll update it)
  - Monopolistic Competition
    - So far firms have not made profits
    - Now they will, but still not monopolies
    - Sometimes called imperfect competition
    - Will 'explain' two-way trade puzzle