

ECO364H1S: International Trade Theory

Lecture 6

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- ▶ Last Class
 - Wrap up standard Heckscher-Ohlin model
 - Why does Factor Price Equalization (FPE) happen in free trade?
 - Factor Content Studies
- ▶ Today
 - Specific Factors Model
- ▶ Readings
 - KMO, Ch. 4

The Specific Factors Model

- ▶ In the Ricardian model, we were not able to say anything about the income distribution
- ▶ But we were able to do this in the Heckscher-Ohlin model
 - Two factors of production
- ▶ In a model with more than one factor, we showed that factors could experience a fall in their real returns
 - Stolper-Samuelson theorem
 - When the price of a good increases, the factor used intensively in the production of that good experiences an increase in real returns
 - The other good experiences a decrease in real returns

The Specific Factors Model

- ▶ The HO model is more suitable for studying the long-run effects of trade
 - We assumed each factor can costlessly transfer across industries within a country where real returns are highest
- ▶ In the short run, factors may find it difficult to move
 - Occupation-specific skills: it takes significant effort, time and resources to change jobs
 - Difficult to repurpose large factories and heavy machinery for other uses
 - Geographic constraints: very high transportation or migration costs makes it difficult for factors to move to locations with better opportunities

Specific Factors Model: Outline

- ▶ Model setup + analysis
- ▶ Autarky equilibrium
- ▶ Trade equilibrium
 - Countries North and South
- ▶ Gains from Trade
- ▶ Note: many ideas here will be similar to what you saw in the HO model

Model Setup

- ▶ Two sectors: Food, F ; Computers, C
- ▶ Three factors in production: Labour, L ; Capital, K ; Land, T
- ▶ Labour is a **mobile factor**: can costlessly move across industries
- ▶ Capital and Land are **specific factors**
 - Land is used only in the food sector
 - Capital is used only in the computer sector

Model Setup

- ▶ The production functions for each industry are denoted by

$$Q_C = Q_C(K, L_C)$$

$$Q_F = Q_F(T, L_F)$$

- ▶ There's a finite stock of labour, \bar{L} , in the economy and in optimum

$$L_C + L_F = \bar{L}$$

Model Setup

- ▶ The marginal product of labour are

$$MPL_C = \frac{\partial Q_C(K, L_C)}{\partial L_C}$$

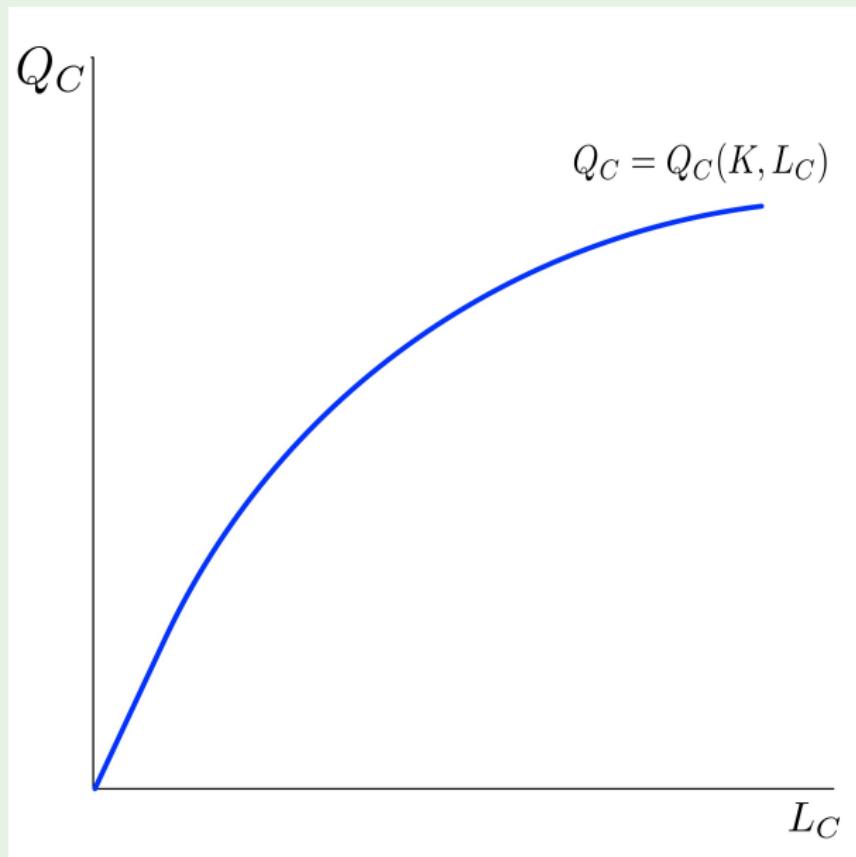
$$MPL_F = \frac{\partial Q_F(T, L_F)}{\partial L_F}$$

- ▶ Just as in the HO model, we will assume that the production functions exhibit diminishing returns in each input
- ▶ For labour, these are just

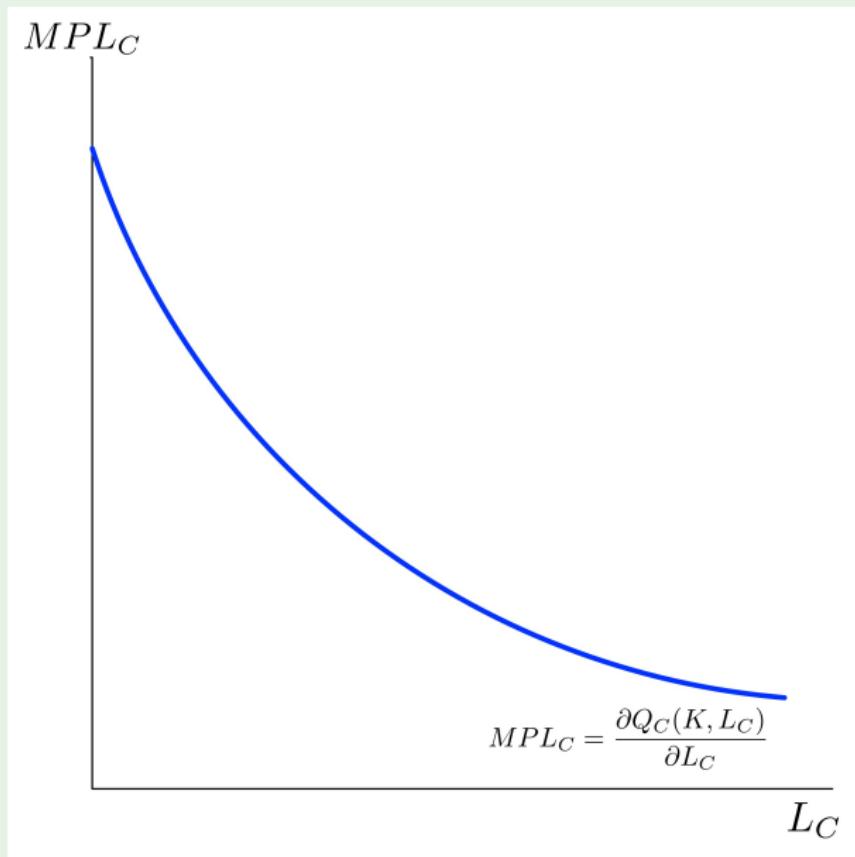
$$\frac{\partial^2 Q_C(K, L_C)}{\partial L_C^2} < 0$$

$$\frac{\partial^2 Q_F(T, L_F)}{\partial L_F^2} < 0$$

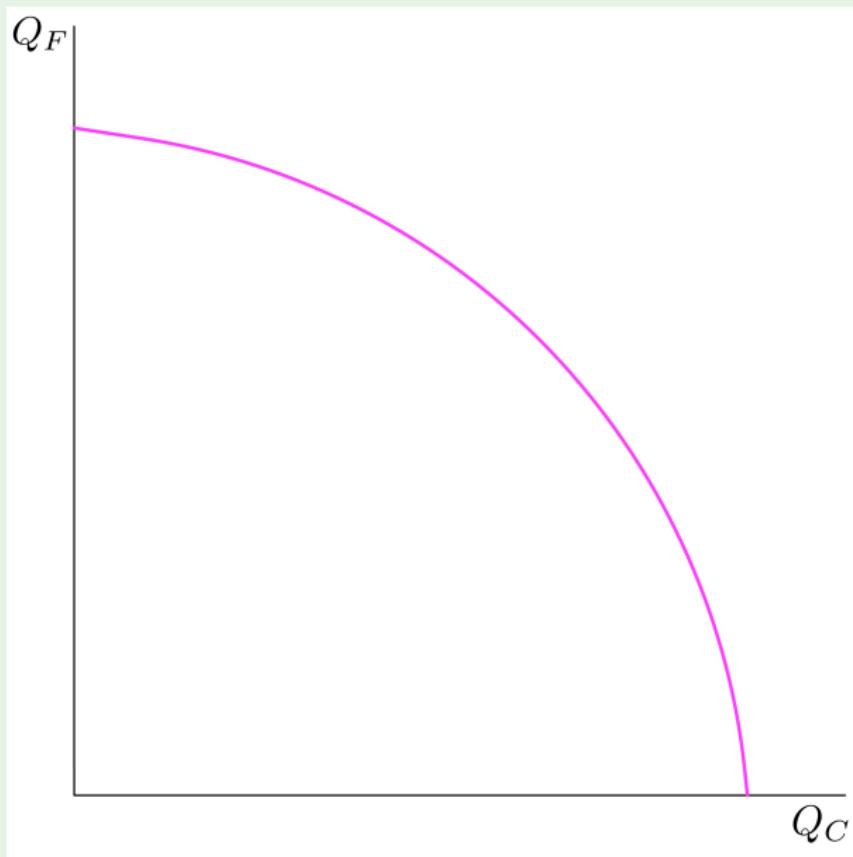
Production Function and Marginal Product of Labour



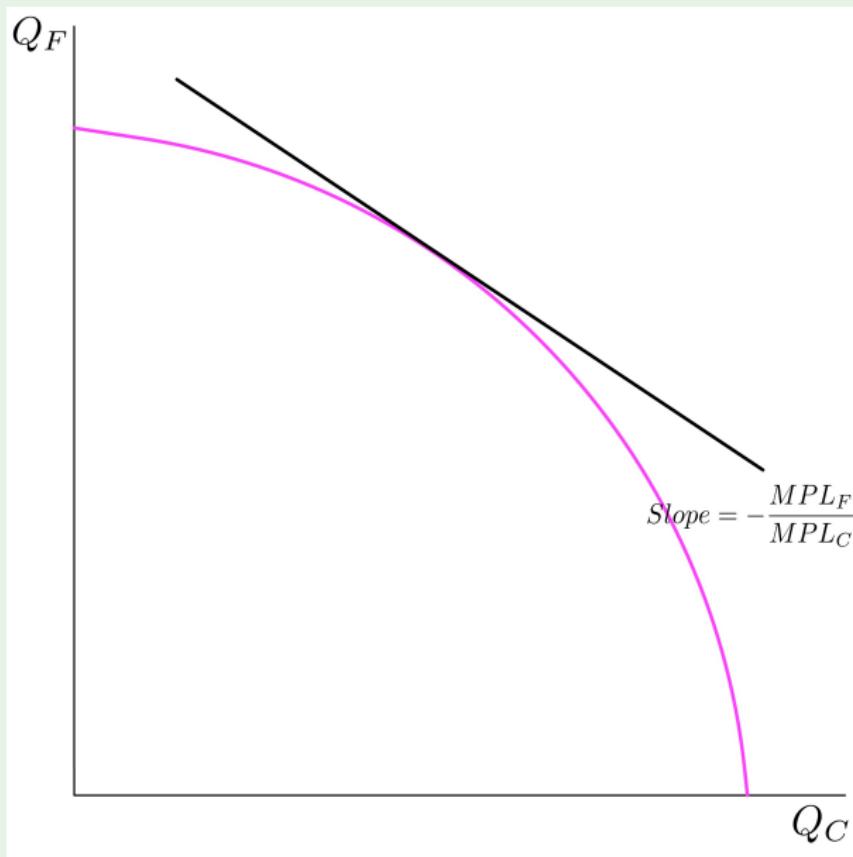
Production Function and Marginal Product of Labour



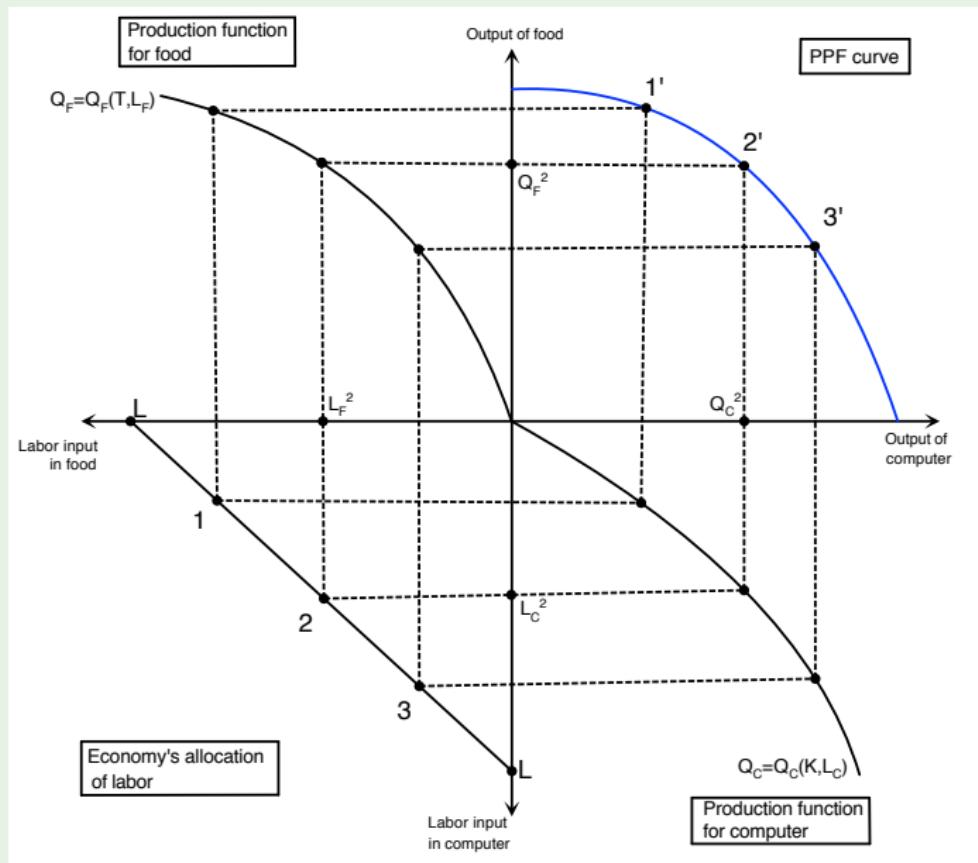
Diminishing Returns and PPF



Diminishing Returns and PPF



How the PPF is constructed



How the PPF is constructed

- ▶ Lower left quadrant
 - Labour allocation in each sector
- ▶ Lower right and upper left quadrant
 - Production functions in each sector as a function of labour
 - Conditional on some given amount of their specific factors
- ▶ PPF bowed out because of diminishing returns
- ▶ How is labour allocated across sectors in this economy?

How labour is allocated across sectors

- ▶ To see how labour is allocated, we need to model the supply and demand for labour in each industry
- ▶ The demand for labour in a given sector depends on the price of the good in that sector and the current wages

Demand for Labour

- ▶ Employers (firms) will hire labour until marginal value produced by the hire is greater than the marginal cost
- ▶ Value of a marginal hire is

$$MPL_c P_c$$

- ▶ Cost of a marginal hire

$$w$$

Demand for Labour

- ▶ If $MPL_C P_C > w$, firm should hire more labour!
- ▶ If $MPL_C P_C < w$, firm hired too much labour
- ▶ $MPL_C P_C = w$ is the optimum
- ▶ Recall, diminishing returns in the production function is the reason why for a large value of L_C , $MPL_C P_C$ is small
- ▶ Similar argument holds for the food industry

Demand for Labour

- ▶ The optimum condition for labour demand, $MPL_C P_C = w$, can be interpreted as the inverse demand function for labour
- ▶ For a given P_C , when nominal wages are too high, firms should hire less labour
 - $MPL_C P_C < w$
- ▶ Similarly, when wages are very low, firms should hire more labour
 - $MPL_C P_C > w$

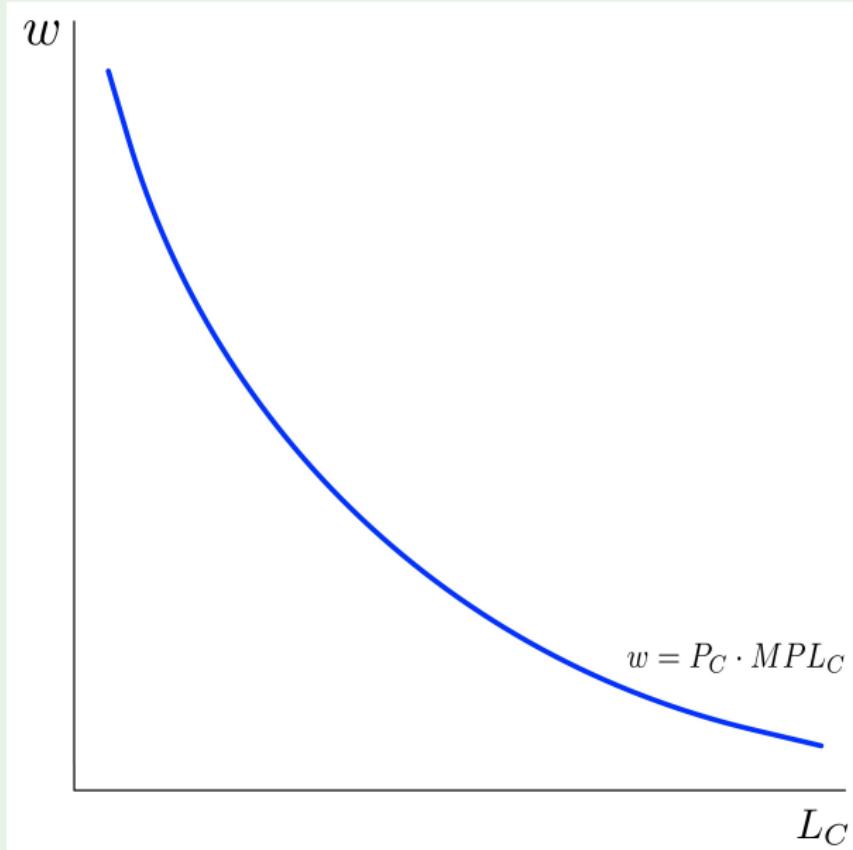
Demand for Labour

- ▶ Demand for labour in the food industry:

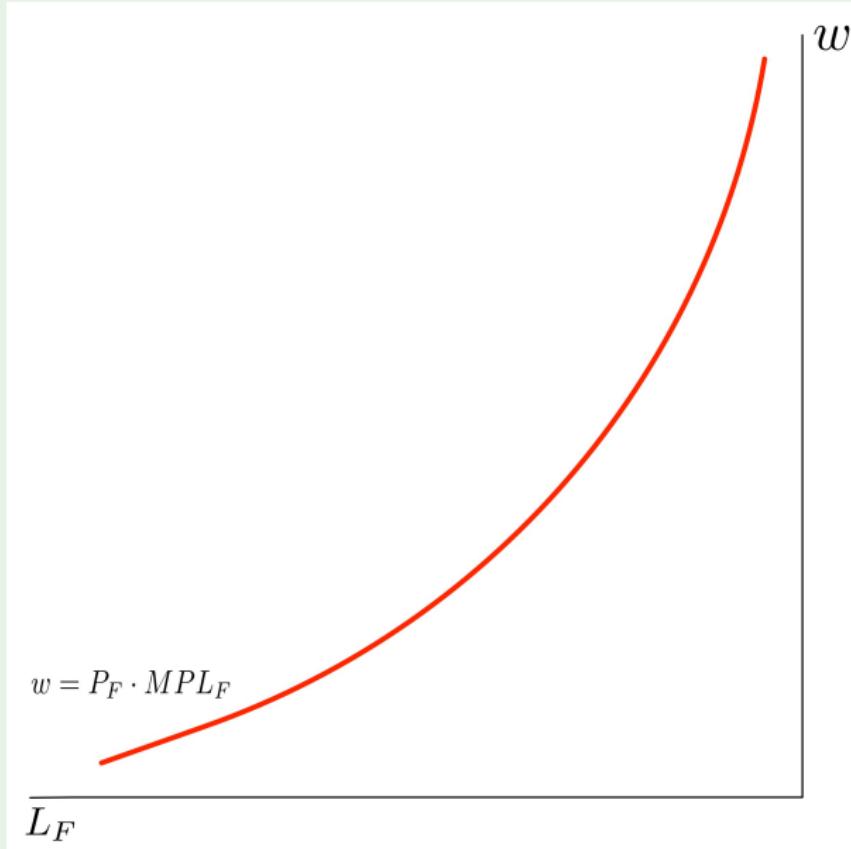
$$MPL_F P_F = w$$

- ▶ Because labour can freely move across sectors, wage between the two sector will equalize
- ▶ Also, in any equilibrium, all resources will be used:
 $L_C + L_F = \bar{L}$

Demand for Labour



Demand for Labour



Demand for Labour

- ▶ It follows that for some given values of P_C , P_F , K , T , and \bar{L} , the equilibrium allocation of labour in each sector, L_C^* and L_F^* , satisfies

$$MPL_C(K, L_C^*)P_C = MPL_F(T, L_T^*)P_F$$

- ▶ and

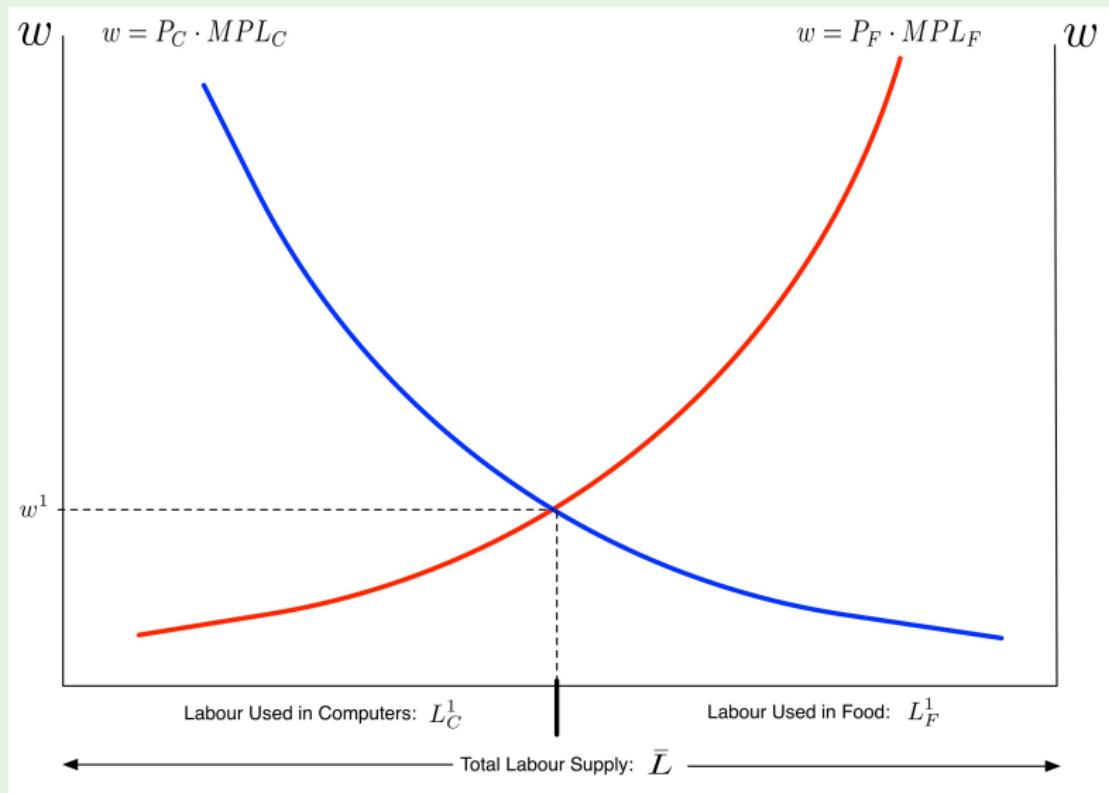
$$L_C^* + L_F^* = \bar{L}$$

Demand for Labour

- ▶ The equilibrium allocation can be shown in what is called the **Scissors Diagram**

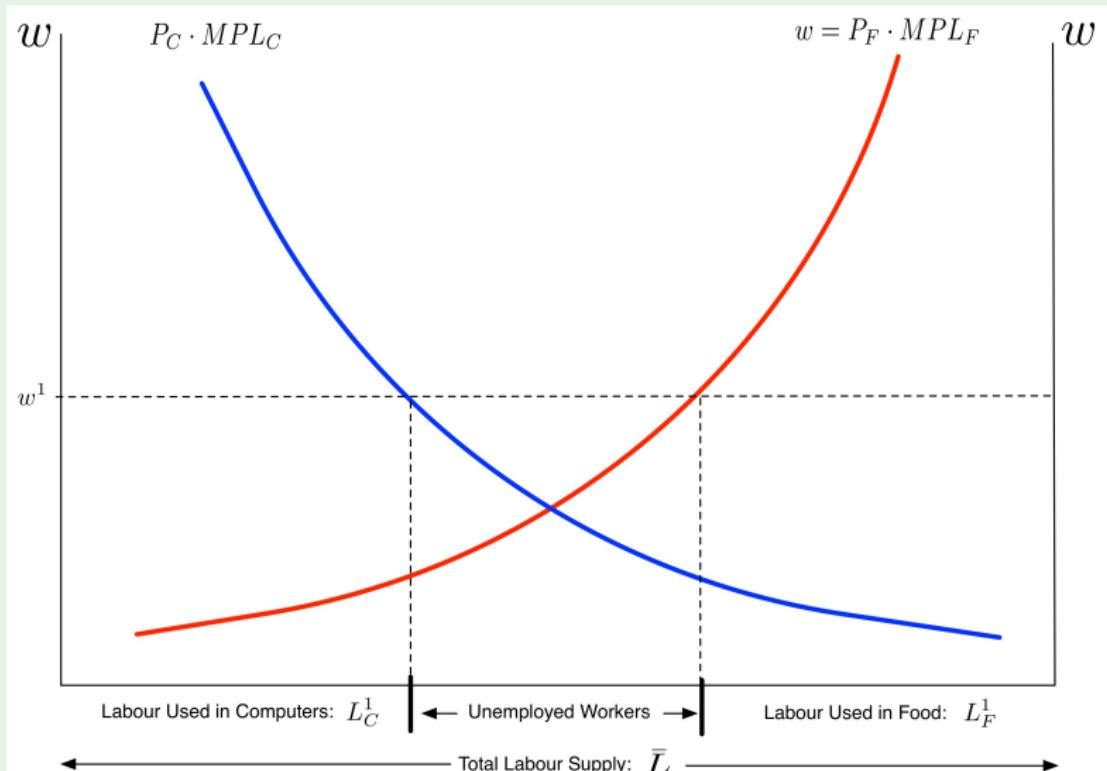
Demand for Labour

Equilibrium wage and labour allocation



Demand for Labour

Suppose wages is higher than the point where the two demand curves cross... (real world scenario where this might happen?)



Relative Goods Prices and Production Pattern

- ▶ From the equilibrium allocation of labour condition, we saw that

$$MPL_C(K, L_C^*)P_C = MPL_F(T, L_F^*)P_F$$

$$\implies \frac{P_C}{P_F} = \frac{MPL_F(T, L_F^*)}{MPL_C(K, L_C^*)}$$

- ▶ This takes us back to our PPF, since $\frac{MPL_F(T, L_F^*)}{MPL_C(K, L_C^*)}$ is just the slope of the PPF at the production output corresponding to the input values of T , K , L_F^* , and L_C^*

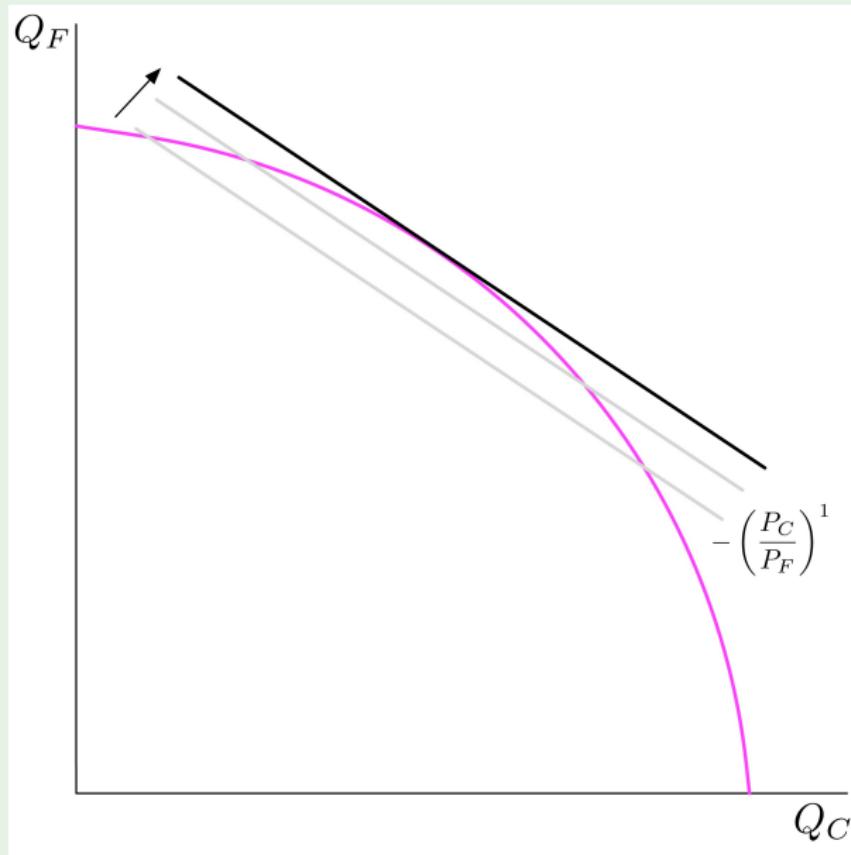
Relative Goods Prices and Production Pattern

- ▶ Any economy will produce the output that maximizes the total value of production

$$V = Q_F P_F + Q_C P_C$$

- ▶ Optimization is subject to resource constraint (PPF)
- ▶ Optimal point is where the line described by equation V is tangent with the PPF curve

Relative Goods Prices and Production Pattern



Changes in Prices

- ▶ With this model set up, change parameters and study changes in new equilibrium
- ▶ We will consider two types of price changes:
 - The price of both goods rises by the same percentage
 - The price of one good rises while the other stays constant

Changes in Prices

- ▶ For each type of price change, we will answer the following questions
 - What happens to output in each sector?
 - What happens to labour allocation across sectors?
 - Who gains from the price change? Who loses?

Equal-Proportion Price Increase: Changes in Output

- ▶ Suppose the price of both computers, P_C , and food, P_F , increased by 10%
 - Assume everything else stays the same
- ▶ P_C/P_F does not change
- ▶ Because relative goods prices does not change, output allocation stays the same:

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

- Same tangency in isovalue line / PPF diagram

Equal-Proportion Price Increase: Labour Allocation

- ▶ What happens to labour allocation?
- ▶ Inverse labour demand functions:

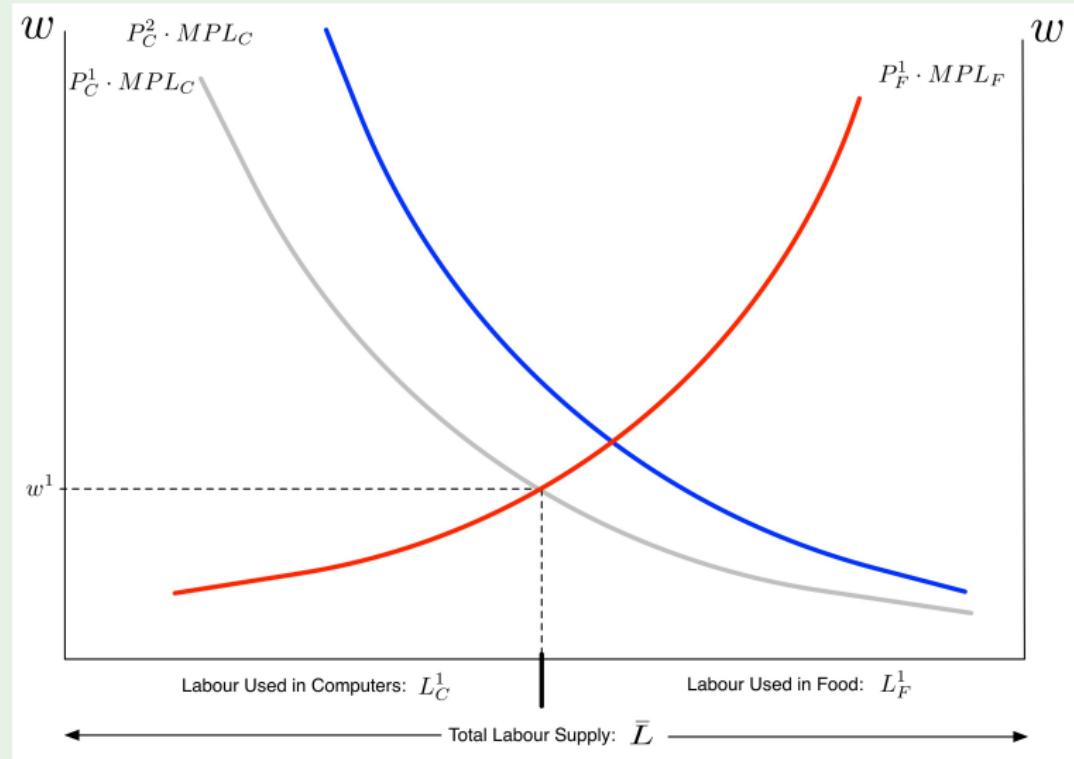
$$w = MPL_C P_C$$

$$w = MPL_F P_F$$

- ▶ For some fixed wage, an increase in goods prices causes the value of the marginal product of labour to be higher than before
 - Firms will demand more workers
 - Wages will increase as a consequence

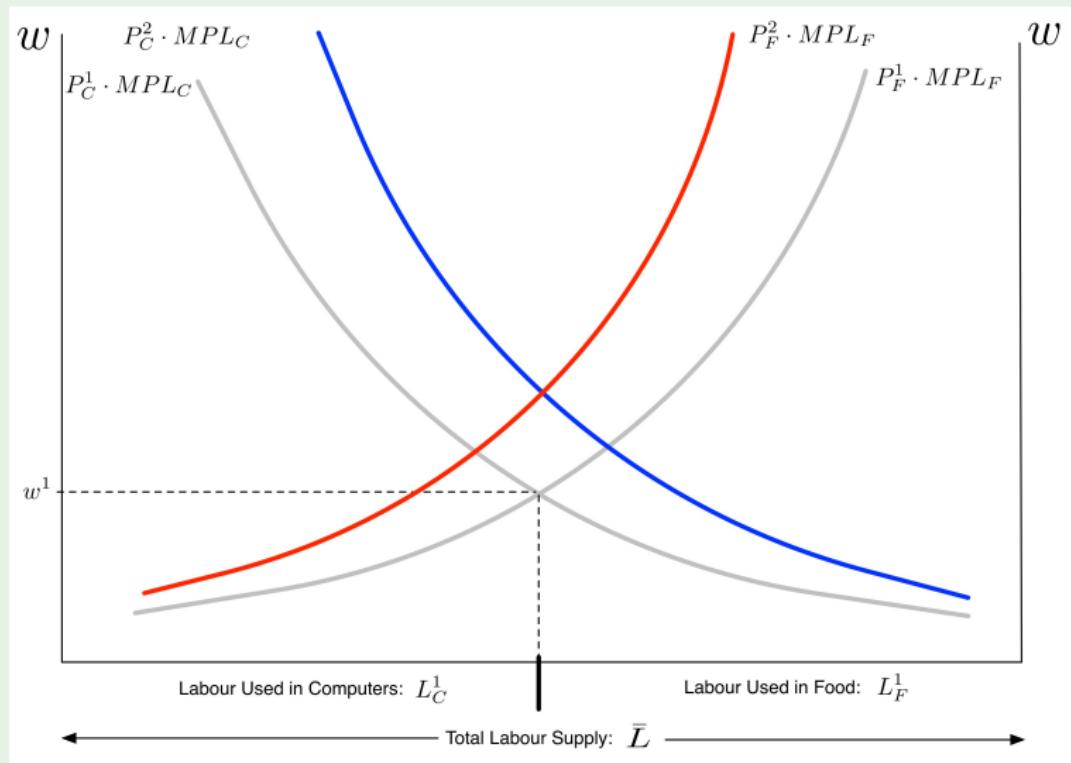
Equal-Proportion Price Increase: Labour Allocation

P_C increased by 10%

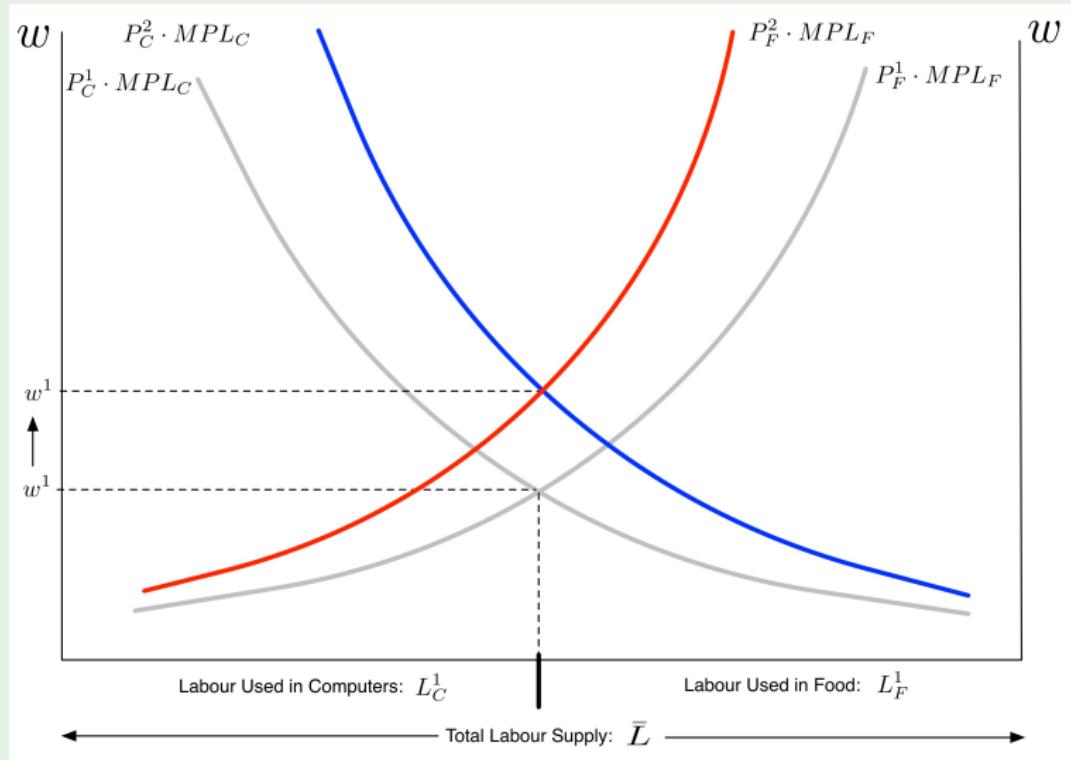


Equal-Proportion Price Increase: Labour Allocation

But P_F also increased by 10%



Equal-Proportion Price Increase: Labour Allocation w increases



Equal-Proportion Price Increase: Gains / Losses

- ▶ From the scissors diagram, we see that an equal proportion change in goods prices results in no changes in the labour allocation
- ▶ For workers, the 10% increase change in price causes a 10% change in nominal wages
 - Real wages, w/P_C and w/P_F , do not change

Equal-Proportion Price Increase: Gains / Losses

- ▶ What about the returns to specific input factor owners (capital and land)?

Equal-Proportion Price Increase: Gains / Losses

- ▶ Consider the capital owners
- ▶ Remember that $MPK_C = \partial Q_C(K, L_C) / \partial K$
 - The marginal product of capital is a function of both capital and labour
- ▶ Because L_C did not change (from scissors diagram), MPK_C stays the same
- ▶ By the marginal revenue = marginal cost condition,
 $MPK_C P_C = r$

Equal-Proportion Price Increase: Gains / Losses

- ▶ Thus, real return to capital in terms of computers does not change
 - $r/P_C = MPK_C$
- ▶ Because, r/P_C is unchanged, r must have increased by 10%
- ▶ Similar argument can be applied to show that the real return to land owners did not change (EXERCISE)

Equal-Proportion Price Increase: Summary

- ▶ In summary, an equal-proportion increase in goods prices results in
 - No changes in relative goods prices
 - No changes in the pattern of production (same output)
 - No changes in the labour allocation across industries
 - No changes in the real wage of workers in both industries
 - No changes in the real returns to capital and land owners

Equal-Proportion Price Increase: Summary

- ▶ In general, if the price of all goods in the economy were to increase by the same proportion, there will be no real economic changes
 - True in the long run
 - However, institutional frictions may exist preventing perfect pass-through of price changes to wages and capital/land returns
 - Market structures other than perfect competition (monopolies, oligopolies, etc.) will also result in a different outcome

Change in Relative Prices

- ▶ Real change is caused by disproportionate changes in prices across goods
 - This causes a change in relative output, as seen from the PPF
 - This, in turn, causes a change in the allocation of labour (which is then followed by changes in production patterns and real returns)

Change in Relative Prices

- ▶ Let's consider the case where the price of computers increases by 7% but the price of food stays the same
- ▶ Denote the previous relative goods price by $(P_C/P_F)^1$ and the new relative goods price by $(P_C/P_F)^2$

Change in Relative Prices

- ▶ Let's ask the same questions:
 - What happens to the production of output in each sector?
 - What happens to how labour is allocated across sector?
 - Who gains from the price change? Who loses?

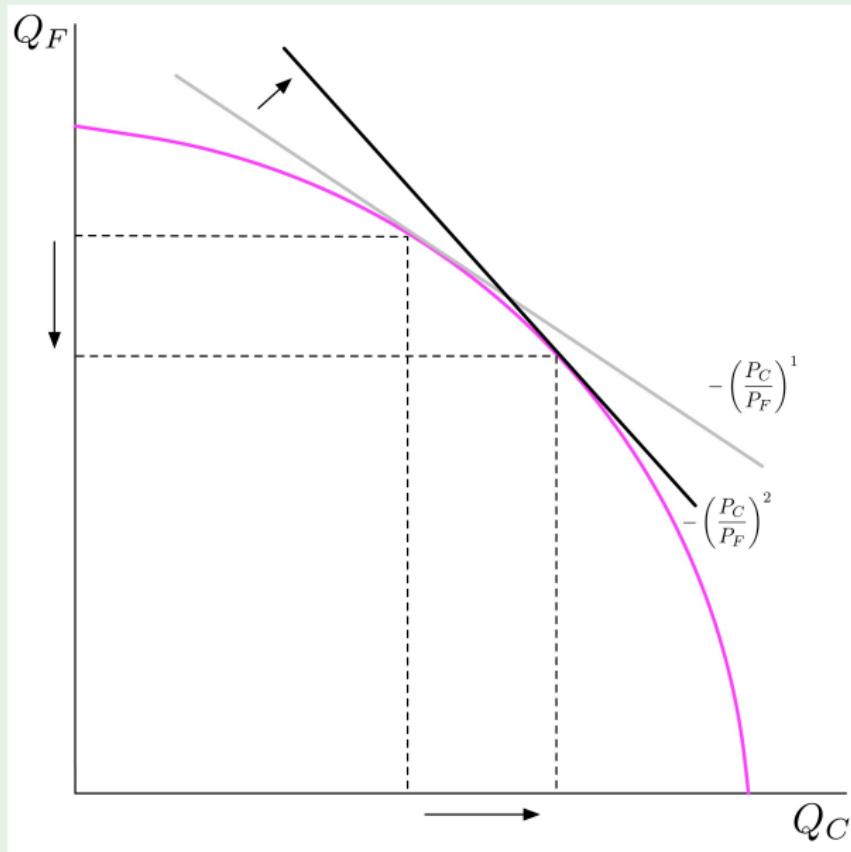
Change in Relative Prices: Changes in Output

- ▶ Change in relative goods prices causes a change in production patterns
- ▶ It changes the slope of the isovalue line equation

$$V = P_C Q_C + P_F Q_F$$

- ▶ The result is that the output of computers increases while that of food decreases

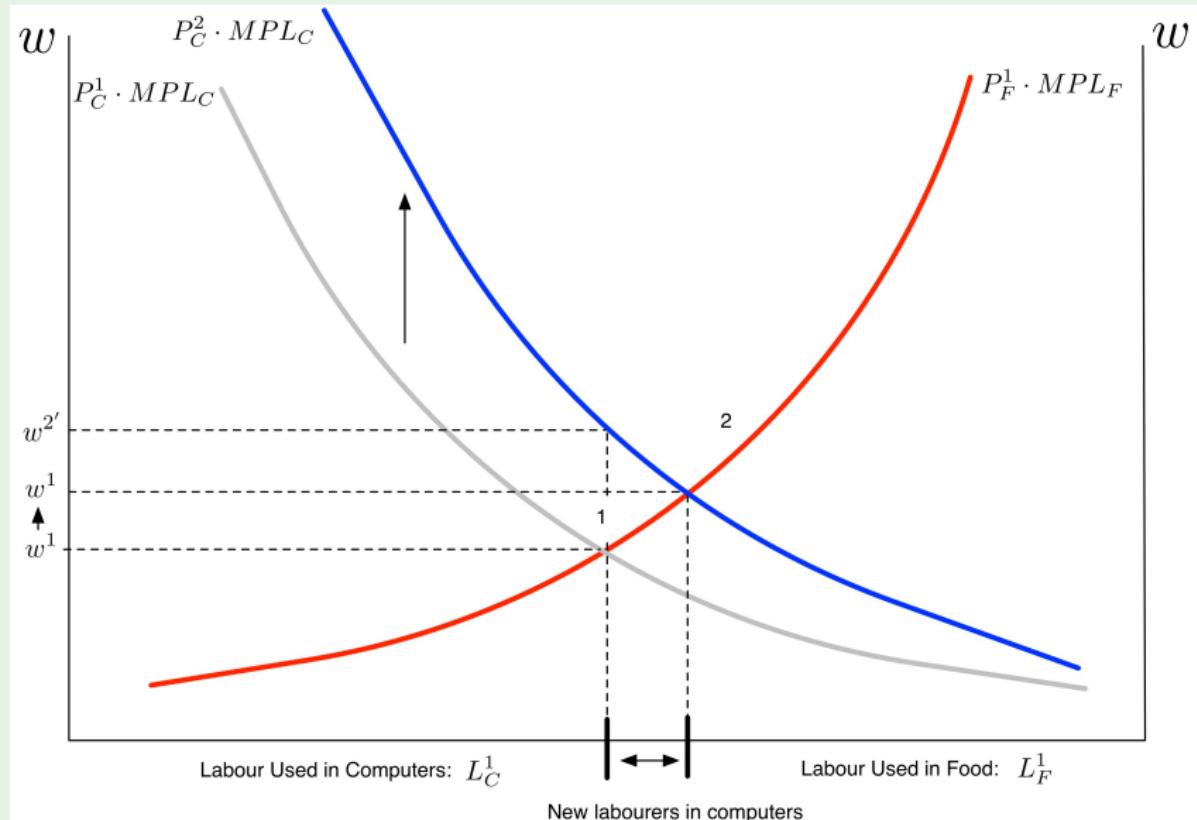
Change in Relative Prices: Changes in Output



Change in Relative Prices: Labour Allocation

- ▶ What's the effect of the relative price change on the allocation of labour?

Change in Relative Prices: Labour Allocation



Change in Relative Prices: Labour Allocation

- ▶ The increase in P_C rotates the labour demand curve up
- ▶ Equilibrium changes from point 1 to point 2

Change in Relative Prices: Labour Allocation

- ▶ Two things to note:
 1. Although w rose, it rose by less than the increase in the price of computers
 - If it were to increase by the same amount, it would be in w^2'
 2. Labour shifts from the food sector to the computer sector
 - This increase in labour working in computers decreases the marginal product of labour in computers (MPL_C)
 - which is the reason why, as noted above, w increased by less than P_C (recall, $w = P_C \cdot MPL_C$)
 - Increase in output is due to more labour being allocated to the computer industry

Change in Relative Prices: Gains / Losses

- ▶ Who gains/loses from the change in relative price?

Change in Relative Prices: Gains / Losses

- ▶ Workers
 - Not obvious
 - w increased, but not by as much as P_C ; therefore, w/P_C fell
 - Since P_F did not change, w/P_F increased
 - Whether workers gain or lose depend on how much they value each good
 - If they value computers more than food, they lose from the price change
 - If they value food more than computers, they gain from the price change

Change in Relative Prices: Gains / Losses

- ▶ Capital owners
 - MPK_C rises because L_C increased
 - Thus, $r/P_C = MPK_C$ increased
 - This suggests that r increased by more than 7%
 - For food sector, because r increased and P_F stayed constant, r/P_F increased
 - Capital owners gain

Change in Relative Prices: Gains / Losses

- ▶ Capital owners:
 - **Aside:** To convince yourself that MPK_C increased, here's a production function and take its derivative with respect to K

$$Q_C = K^{2/3} L_C^{1/3}$$
- MP of machine decreases as you add more machines (limited powersupply and workers), but for a given # of machines, MPK increases when additional workers are added to supplement them
 - For a fixed value of K , marginal productivity of capital increases as L increases

Change in Relative Prices: Gains / Losses

- ▶ Landowners
 - Landowners lose
 - MPT_F decreases because labour has moved to the computer industry (lower MPT_F for all values of T)
 - r_T/P_F decreases, which means r_T decreased since P_F did not change
 - r_T/P_C decreases by more than 7% since r_T fell and P_C increased

Change in Relative Prices: Gains / Losses

- ▶ EXERCISE: What if the price of food drops while the price of computers remained the same?

Change in Relative Prices: Summary

- ▶ The factor specific to the sector whose relative price increased (computers) are better off
 - Capital owners
- ▶ The factor specific to the sector whose relative price decreased (food) are worse off
 - Landowners
- ▶ The change in welfare of the mobile factor is unclear
 - It depends on how much workers value computers over food

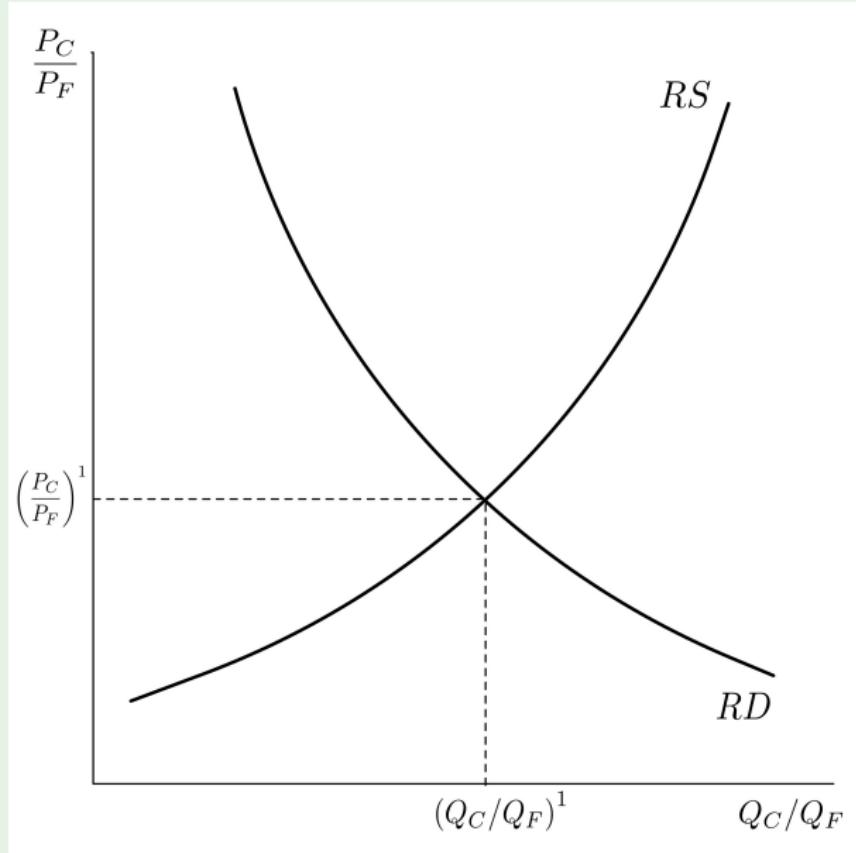
Autarky Equilibrium

- ▶ So far, we assumed some exogenous price change
- ▶ Let's tie price changes to international trade

Autarky Equilibrium

- ▶ Just like the Ricardian and Heckscher-Ohlin models, prices come from the intersection of the relative demand (RD) and relative supply (RS) curve
- ▶ Relative Demand:
 - Homothetic and identical preferences across countries
- ▶ Relative Supply:
 - Comes from the PPF diagram which, itself, is based on factor endowments
- ▶ The intersection of the relative demand and relative supply curve gives us the equilibrium relative price and quantity of a country

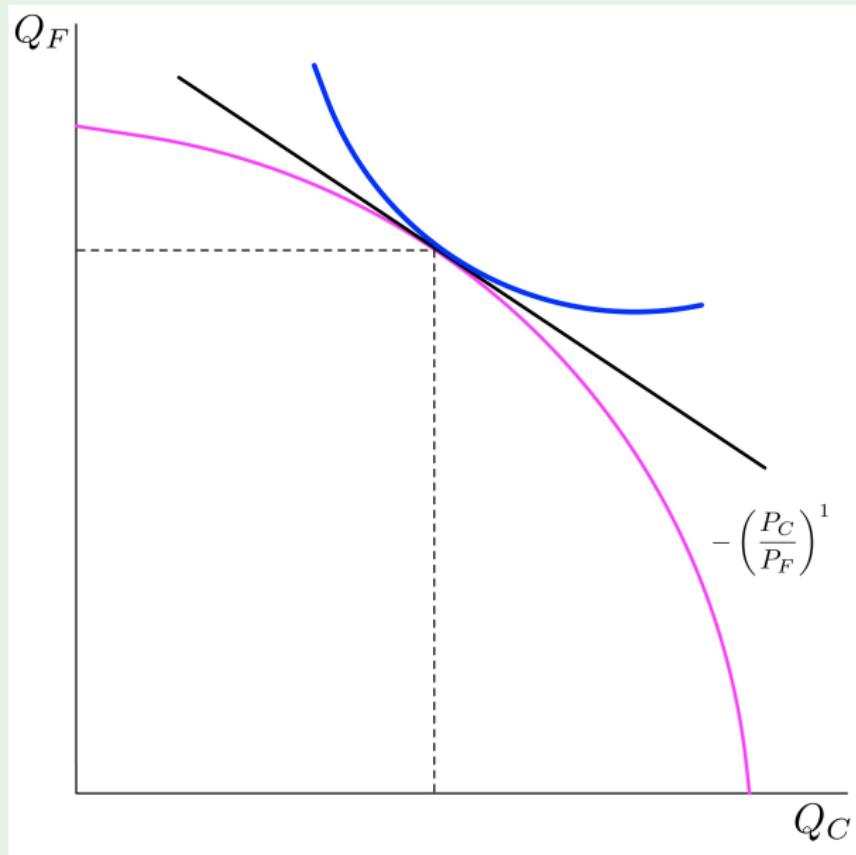
RS and RD curves



Equilibrium under Autarky

- ▶ Based on the equilibrium relative price pinned down by the intersection of the RD and RS curves, we can derive the optimal level of production in each sector
- ▶ We do this by going back to the PPF diagram
- ▶ The equilibrium is one where the PPF, isovalue line, and the indifference curve are tangent to each other and have the same slope
 - Note that in autarky, consumption is equal to production for all goods

Equilibrium under Autarky



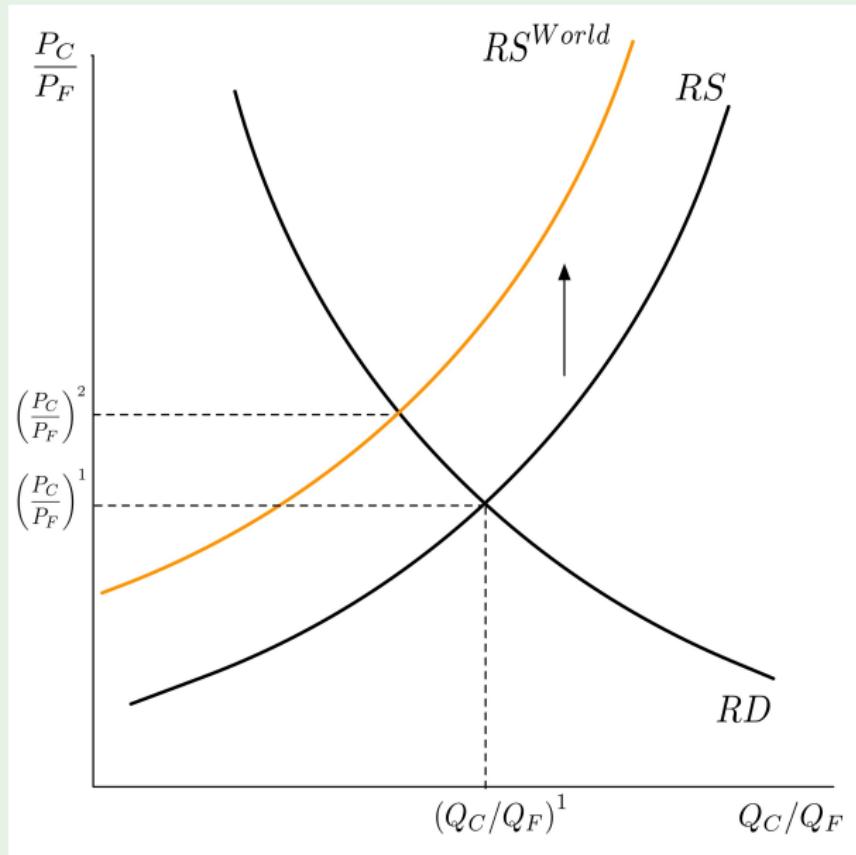
Trade Equilibrium

- ▶ As before, when countries trade, world relative price is determined by the world RD and the *world* RS curves
- ▶ Assume that the country we are analyzing is relatively capital abundant, which means they have a comparative advantage in computers

Trade Equilibrium RD / RS

- ▶ World RS moves to the left of autarky RS of our country
- ▶ The world is relatively less productive at producing food than the South and relatively less productive at producing computers than the North
- ▶ World RD is the same as before
 - By the homothetic and identical preferences assumption

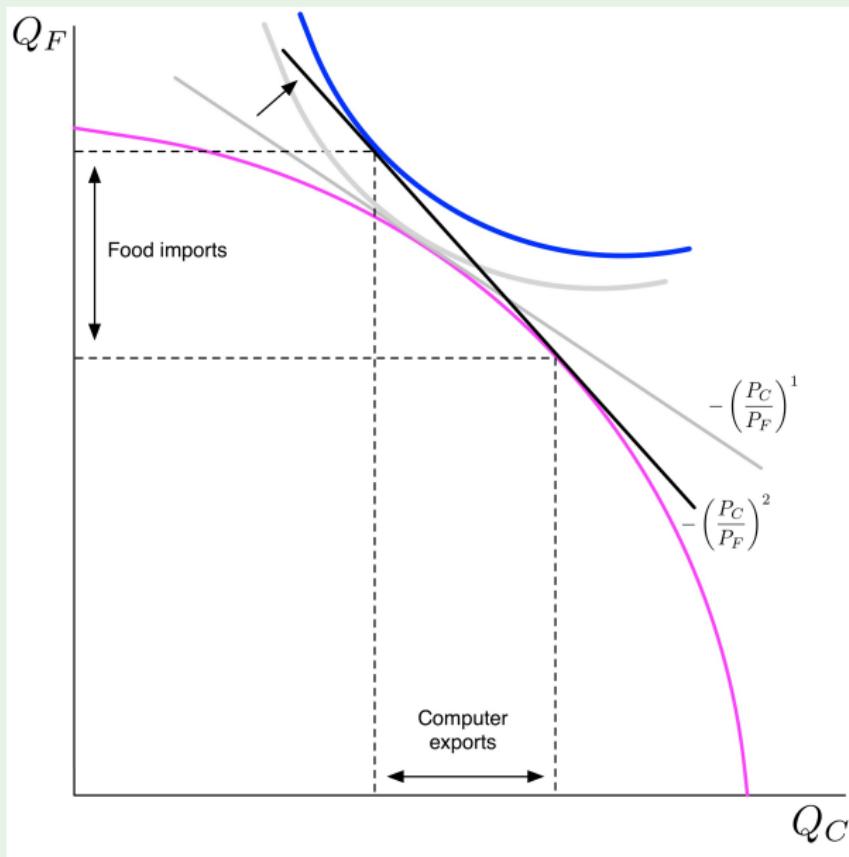
Trade Equilibrium: RD / RS



Trade Equilibrium: Equilibrium Quantities

- ▶ The trade equilibrium results in relative prices that are higher than relative prices in autarky
- ▶ Given these relative goods prices, we can see how production patterns change using the PPF, the isovalue line, and indifference curves

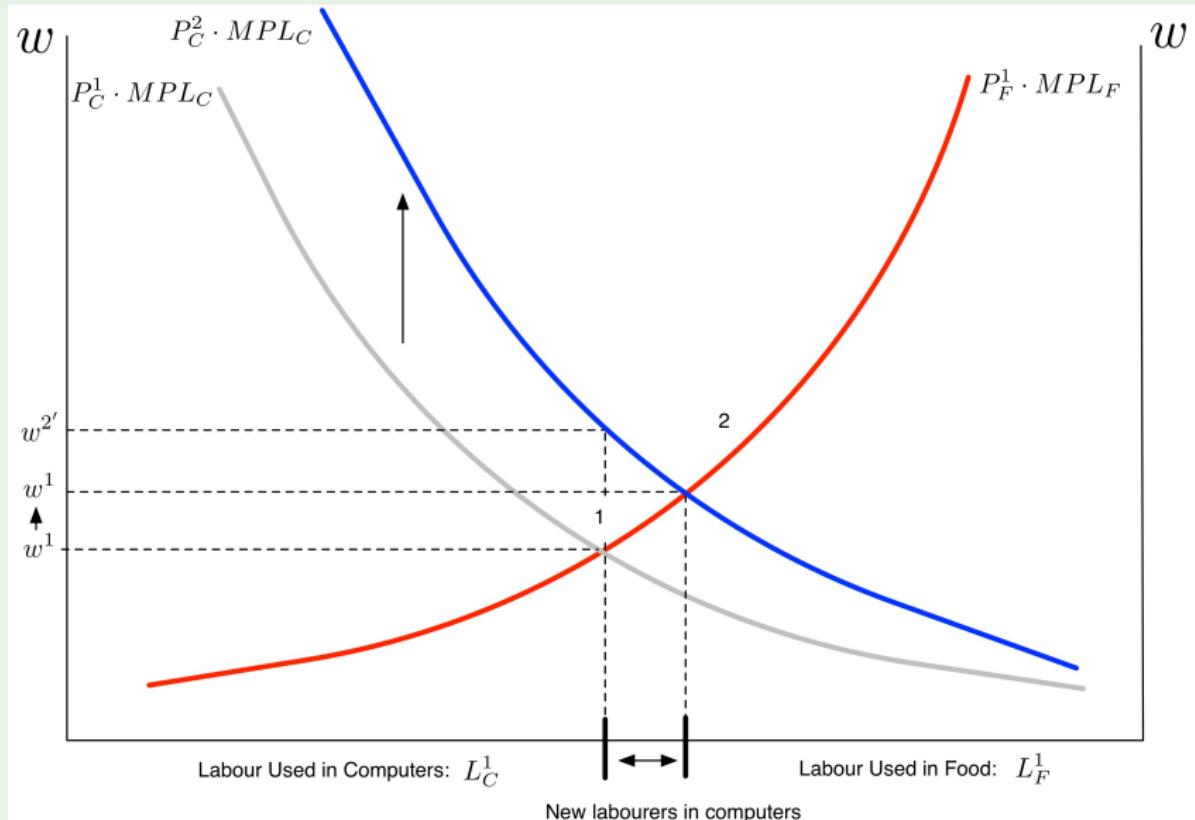
Trade Equilibrium: Equilibrium Quantities



Gains from Trade

- ▶ In aggregate, our country gains from trade
 - They attain a higher indifference curve in the PPF diagram
- ▶ But just like in the HO model, we need to look at real returns to each factor
- ▶ We can study real returns by going back to the scissors diagram and examine how—as a result of the price changes from trade— w and the marginal product of labour in each sector changed

Gains from Trade



Gains from Trade: Real Returns

	Nominal	Real in computers	Real in foods
Worker	w	w/P_C	w/P_F
Capital owner	r	r/P_C	r/P_F
Landowner	r_T	r_T/P_C	r_T/P_F

- ▶ Just like before, the welfare analyses involves three factors and six values
- ▶ Workers lose in terms of computers, but gain in terms of food
- ▶ Capital owners gain in terms of both goods
- ▶ Landowners lose in terms of both goods

Gains from Trade

- ▶ Stating these results in terms of how trade affects welfare:
 - Trade benefits the factor that is specific to the export sector (capital for computers) and harms the factor that is specific to the import-competing sector (land for food)
 - The welfare effect of trade on the mobile factor is ambiguous

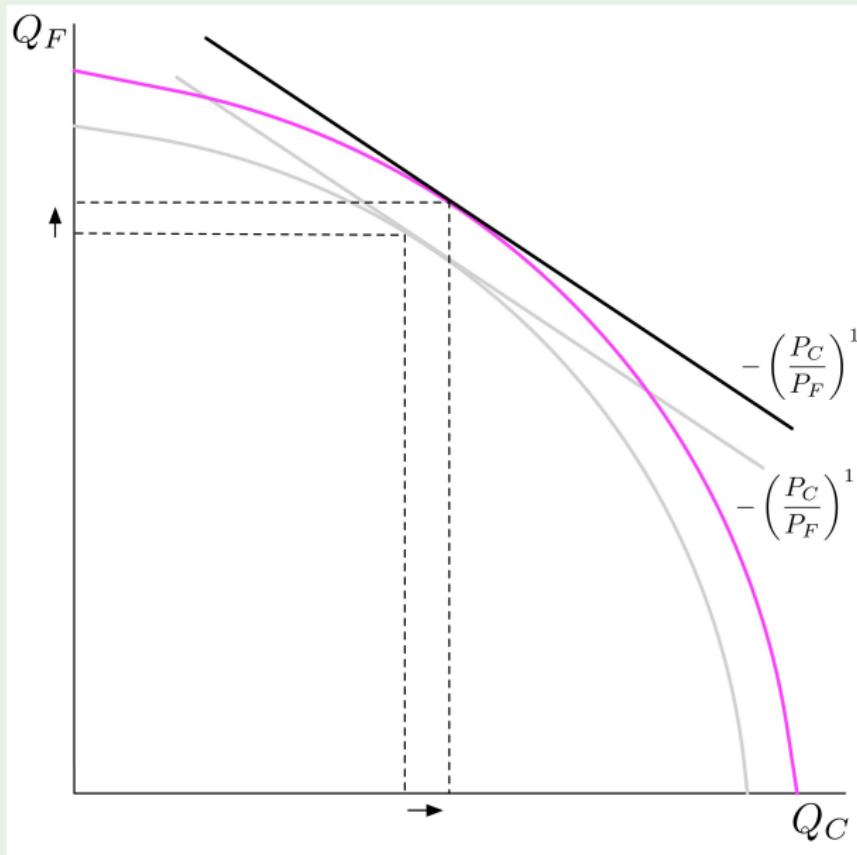
Questions

- ▶ We can use the specific factors model to ask other questions and study its welfare implications
 - What happens if labour stock increases or decreases?
 - Immigration, brain drain
 - What happens if capital stock increases?
 - What happens when consumer preference changes?
 - Homothetic to non-homothetic
 - Different budget allocation between the rich and the poor
 - What if labour cannot move between sectors?
 - Occupation-specific skills

Increase in Labour Stock

- ▶ Let's consider the case where labour stock increases
- ▶ Suppose our country relaxes its immigration policy and allows labourers from other countries to enter

Increase in Labour Stock: PPF



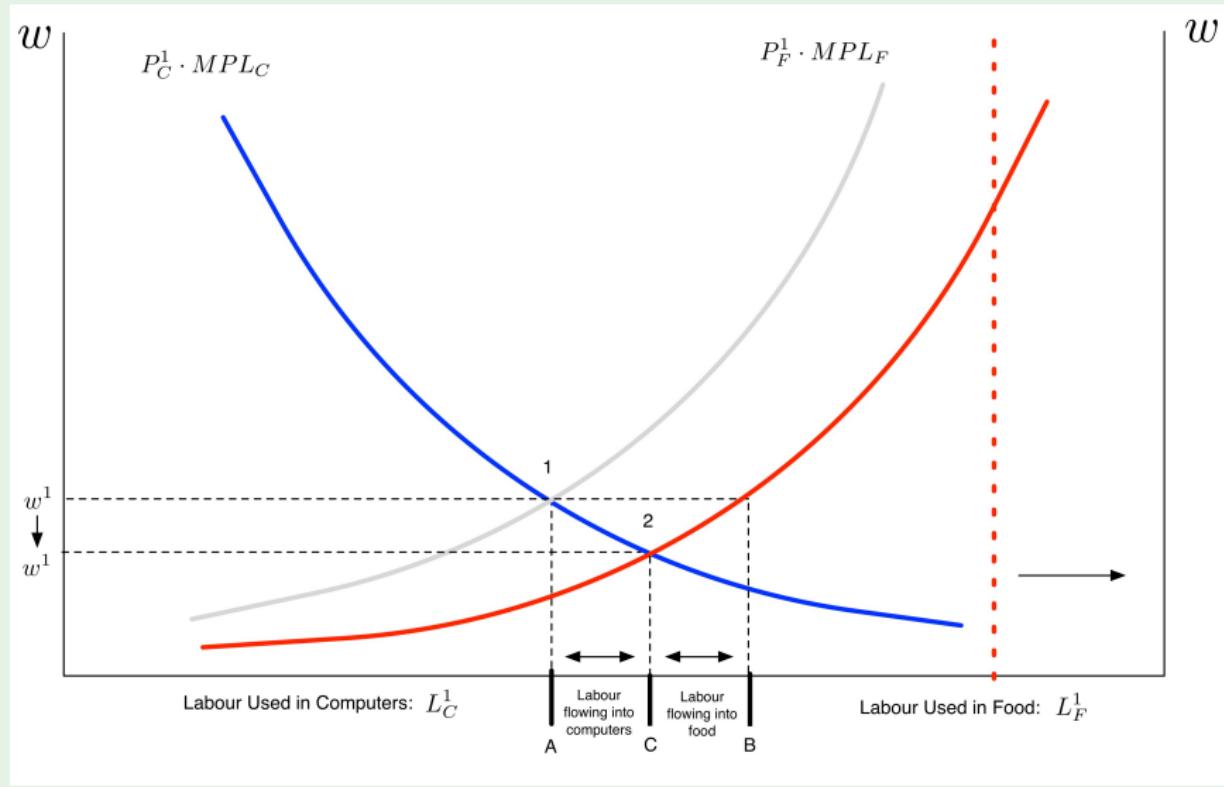
Increase in Labour Stock: PPF

- ▶ More labour in the economy means the PPF expands outward
- ▶ Note that labour is just as intensive in computers as it is in food
 - Equal change across all points on the PPF
- ▶ Since price levels did not change, production of both goods increases

Increase in Labour Stock: Scissors Diagram

- ▶ Let's see how this increase in labour stock is depicted in the scissors diagram

Increase in Labour Stock: Scissors Diagram



Increase in Labour Stock: Scissors Diagram

- ▶ As the horizontal axis shifts out, it takes the $w = P_F MPL_F$ curve with it
 - Nothing else changed except the range of values in the domain of the function
- ▶ At the old equilibrium wage w^1 , labour in computer will be at A and labour in food will be at B
 - These are the same labour quantity before the labour stock increase
- ▶ Because w^1 is too high for the new labour demand curve, the unemployed workers will bid down the wage
- ▶ Nominal wage falls resulting in a move from point 1 to point 2
- ▶ Both sectors now have more workers

Increase in Labour Stock: Gains / Loses

- ▶ Workers:
 - P_C and P_T have not changed, but w is lower—workers purchasing power have decreased
- ▶ Capital owners:
 - MPK rises because there are now more labourers per machine
 - r/P_C rises and since P_C did not change, r must have increased
 - Both real and nominal returns to capital increased
- ▶ Landowners:
 - MPT rises with more labour
 - r_T/P_F increases, which means r_T increased because P_F did not change
 - Both real and nominal returns to land increased

Increase in Labour Stock: Gains / Loses

- ▶ These outcomes show that in a model with specific factors, the Rybczynski theorem no longer holds
 - *Rybczynski theorem*: an increase in the endowment of a factor increases the output of the industry using that factor intensively, and decreases the output of the other industry
- ▶ In the specific factors model, an increase in labour endowment increases the output in both industries

Conclusion

- ▶ The specific factors model allows us to study some of the short-run implications of trade
 - We do this by introducing factors that are specific to an industry—due to prohibitively expensive adjustments in the short run
- ▶ Just like in the HO model, we were able to study the effects of trade on the income distribution and on aggregate welfare
- ▶ Factors experiencing the relative price increase are better off whereas the other factor are worse off
 - Welfare effect on the mobile factor depend on preferences over goods