

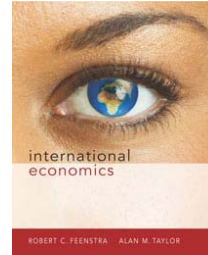
Advanced International Economics

ECON 758

Professor Yamin Ahmad

Lecture 4:

- The Heckscher-Ohlin Model
- Extensions of Heckscher-Ohlin



Topics to be Covered

- Heckscher-Ohlin (HO) model and assumptions
 - > Factor endowment
 - > Factor intensity
- Heckscher-Ohlin Theorem + Proof
- Trade equilibrium in the HO model
- Extensions to Heckscher-Ohlin:
 - > Rybczynski Theorem
 - > Factor Price Equalization Theorem
 - > Stolper-Samuelson Theorem

Note: These lecture notes are incomplete without having attended lectures

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Heckscher-Ohlin (HO) Model

- Eli Heckscher and Bertil Ohlin, Swedish economists
- Model based on two concepts:
 1. **Factor endowments** — the quantities of productive resources possessed by a country
 2. **Factor intensity** — the amount of labor per unit of capital used in production of a product

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Assumptions of HO Model

- Keep first 10 assumptions (from lectures 2 and 3)
- Drop assumption 11 (labor is only resource) and 12 (constant returns to scale between labor and output)
- Add five new assumptions

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Five New Assumptions

- **Assumption 13** — **Two resources**, labor (L) and capital (K), and resource payments, wages for labor (W) and rent for capital (R)
- **Assumption 14** — **Identical technology in both countries**; choice of production technique depends on factor prices
(Note: this assumption rules out the classical basis for trade)

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New Assumptions (cont.)

- **Assumption 15** — **Production of good T is more labor-intensive than that of good S**. Production of both goods in both countries is subject to constant returns to scale.
- **Capital (Labor)-intensive** — a good is capital (labor)-intensive relative to another if its production requires more (less) machines per worker than the other good requires in its production.

- Mathematically, assumption 15 requires: $\frac{K_S}{L_S} > \frac{K_T}{L_T}$

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New Assumptions (cont.)

- **Assumption 16** — **Country A is relatively capital-abundant while B is relatively labor-abundant**.
- Two definitions of resource abundance:
 - **Quantity definition**:- uses factors, i.e. capital and labor
 - **Price definition**:- uses factor prices, i.e. rental rates of capital, wages

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Capital Abundance

- Country A is relatively **capital-abundant** if:

$$K_A / L_A > K_B / L_B \quad (\text{Quantity definition}) \quad \text{or}$$

$$R_A / W_A < R_B / W_B \quad (\text{Price definition})$$

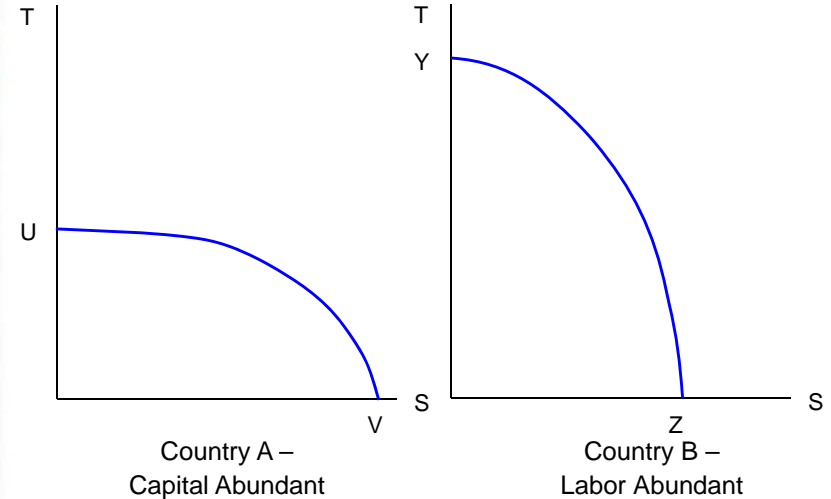
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Production Possibility Frontier

- Since the two goods differ in factor intensity in both countries, the PPFs of each country will exhibit increasing opportunity cost (i.e., PPF will have a bowed out, nonlinear shape).
- Because country B is labor-abundant and good T is labor-intensive, B's PPF will lie primarily along (or biased toward) the T-axis (see next slide).

PPF's in the Two Countries



Assumption 17

- **Tastes in the two countries are identical.** That is, both countries have the same set of social indifference curves (SIC).
- This assumption guarantees that a country's comparative advantage is determined primarily by supply, not demand, factors.

Heckscher-Ohlin Theorem

- **Heckscher-Ohlin Theorem:** A country will have comparative advantage in, and therefore will export, that good whose production is relatively intensive in the factor with which the country is relatively well-endowed.



Graphical Intuition of HO Theorem

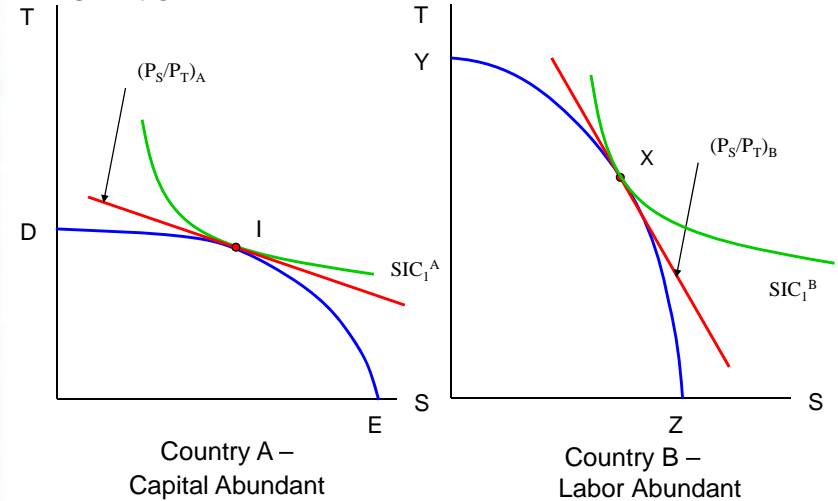
- Given **different PPFs** for the two countries and **identical SICs**, first find autarky equilibrium points for both countries
- At the equilibrium point, the slope of each country's PPF equals the pre-trade price ratio
- If $(P_S/P_T)_A < (P_S/P_T)_B$, then A(B) has comparative advantage in, and will export, good S(T)

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Intuition of HO Theorem Through Quantity Definition



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The HO Theorem using the Price Definition

- In order to see the proof of the HO Theorem using the price definitions, we need to understand an additional tool:
 - **Production Isoquants**
- Def: A **Production Isoquant** describes the various combinations of inputs required to produce a fixed quantity of a given product

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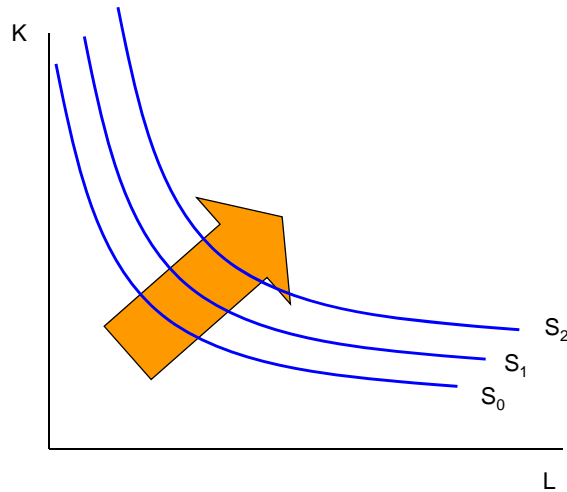
Brief Digression: Isoquants

- From assumption 13, the two resources need to produce goods S and T are **capital** and **labor**.
- Note: Isoquant interpretation is similar to that of an indifference curve for consumers; however isoquant refers to production.
- As with indifference curves, higher level isoquants refer to greater levels of output.

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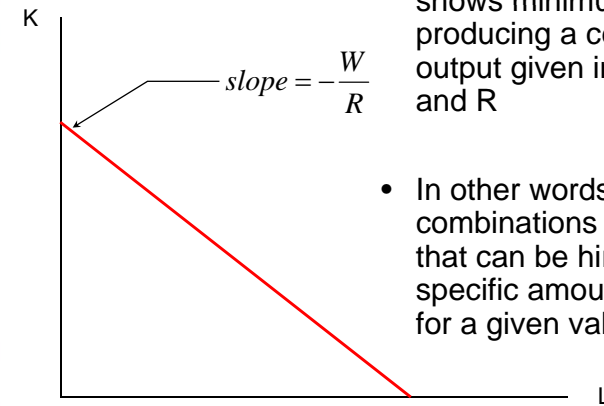
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Isoquants: An example in production of S



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Isocost (Price Line)



- **Definition:** **Isocost line** shows minimum cost of producing a certain level of output given input prices, W and R
- In other words, it shows the combinations of K and L that can be hired with a specific amount of money, for a given value of W and R

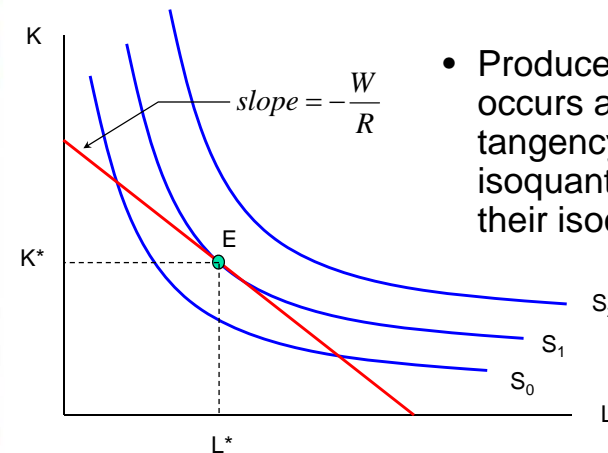
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Question...

- Given that an isocost line shows combinations of K and L that can be hired with a given amount of money for some wage, W , and rental rate, R ,...
- ... write down the equation of an isocost line, for some cost level, C !
- [Hint: hopefully you have realized that an isocost line is essentially a price line. It is the equivalent of the budget constraint from the consumer's problem. Use this to guide you in writing the equation down...]

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Producer: Cost Minimization

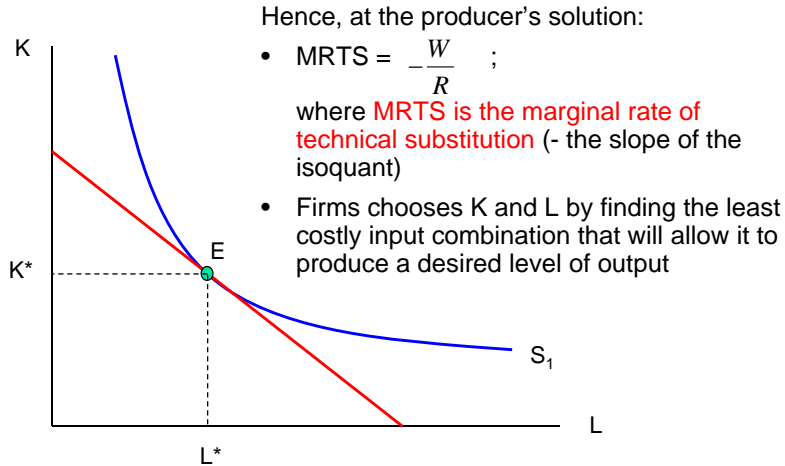


- Producer's solution occurs at the tangency point of an isoquant curve and their isocost line.

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The Lerner Diagram



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Proof of HO Theorem Through Price Definition

- **Recall:**
 - > Country A (B) is relatively abundant in K (L)
 - > Good S (T) is relatively K (L) intensive in its production

Underlying economic intuition behind proof:

- We want to show that when we have autarky $(W/R)_A > (W/R)_B$, then $(P_T/P_S)_A > (P_T/P_S)_B$

[... or equivalently, $(P_S/P_T)_B > (P_S/P_T)_A$]

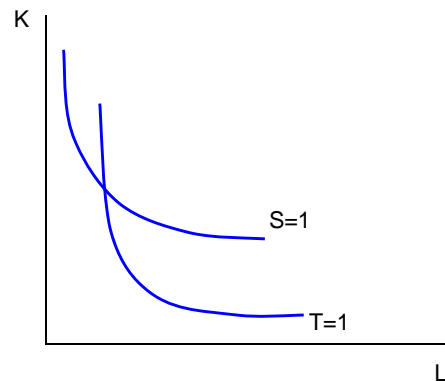
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Proof of HO Theorem

- Suppose we superimpose the isoquants for good S and T onto a single diagram
- Each isoquant represents the various technologies required to produce exactly 1 unit of S and 1 unit of T
- Constant Returns to Scale implies other isoquants can be achieved by scaling inputs appropriately.



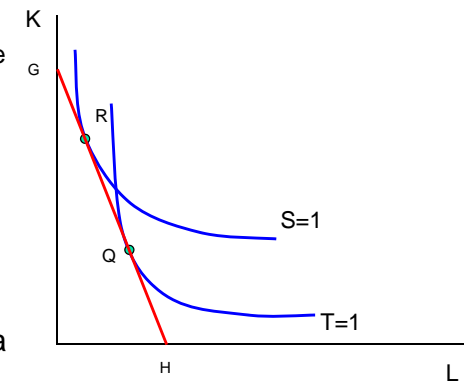
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Proof of HO Theorem

- Note: S isoquant is closer to the K axis
 - > Reflects that S is more capital intensive
- Recall that firm chooses its input combinations by finding the least costly input combination that allows it to produce a desired amount

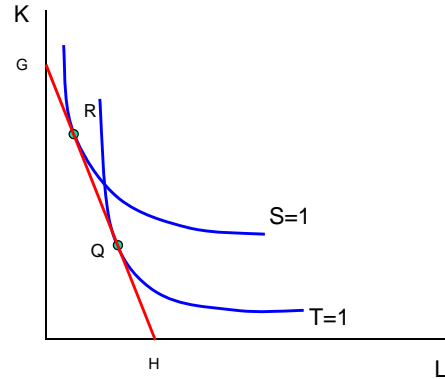


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Proof of HO Theorem

- Suppose in A: $P_S/P_T=1$, i.e. $P_S=P_T$
 - Then line GH must be pre-trade cost constraint facing firms in country A
- Why? - Cost of producing 1 unit of S OR T must be identical along isocost line!



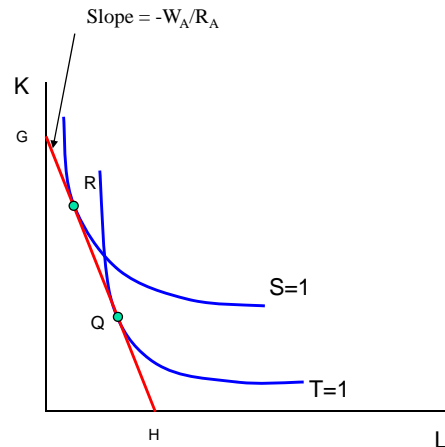
Proof of HO Theorem

Consider that:

- Total cost of producing 1 unit = Marginal cost of producing that unit
 - In perfect competition, firms set price equal to marginal cost, i.e. $P = MC$
- Based on this, we can characterize points G and H as follows:

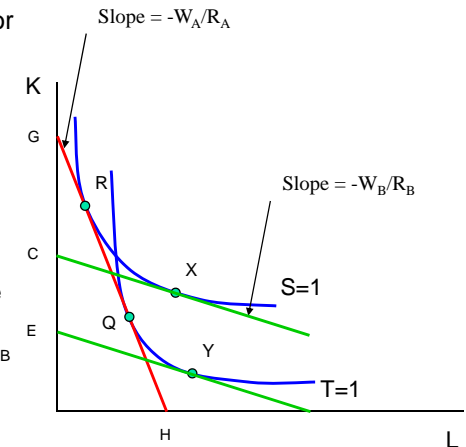
Proof of HO Theorem (cont.)

- At G:
 - $(TC = MC_{SA} = P_{SA} = MC_{TA} = P_{TA})/R_A$
- Similarly, at H:
 - $(TC = MC_{SA} = P_{SA} = MC_{TA} = P_{TA})/W_A$
- Also, the slope of the line GH equals $-W/R$ in country A.



Proof of HO Theorem (cont.)

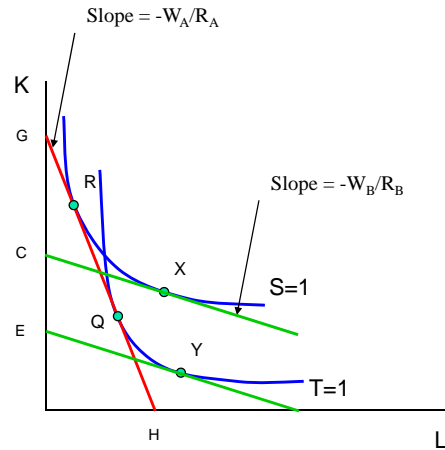
- Consider Country B (labor abundant):
 - Hence, in country B, it must be that: $W_B/R_B < W_A/R_A$
- Thus GH cannot be for country B!
 - We must have separate isocost lines for country B each with slope W_B/R_B
- Optimal choices for producing 1 unit of each good given by X and Y





Proof of HO Theorem (cont.)

- Note: isocost line to produce 1 unit of S in B is higher than the isocost line to produce 1 unit of T in B ...
- ... hence $MC_{SB} > MC_{TB}$
- Since $P = MC$ (= TC for 1 unit's production), this means that $(P_S > P_T)_B$!



Proof of HO Theorem (cont.)

- In country A: $(P_S/P_T)_A = 1$
- In country B: $(P_S/P_T)_B > 1$
- Thus: $(P_S/P_T)_B > (P_S/P_T)_A$, and so:
 - > Country A has a comparative advantage in S
 - > Country B has a comparative advantage in T
- ... QED//



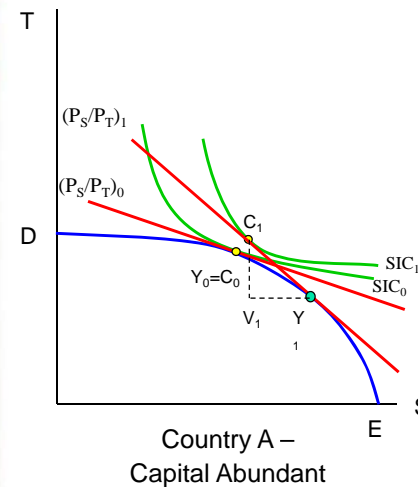
Trade Equilibrium in HO Model

Consider the effects of International Trade:

- From earlier, we know that differences in relative prices will not persist
 - > Price of S (T) in country A (B) will begin to rise
 - > Price of T (S) in country A (B) will begin to fall
- Focus on a particular country, e.g. country A



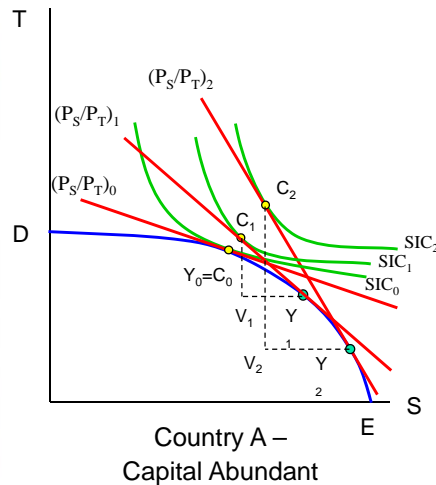
Trade Equilibrium in HO Model (cont.)



- As countries engage in trade, the TOT rises!
 - > Production of T declines and factors are redeployed to production of good S
- Supply of S > Demand for S (locally)
 - > Export S to country B in exchange for imports of T
- Exports = $V_1 Y_1$
- Imports = $V_1 C_1$



Trade Equilibrium in HO Model (cont.)



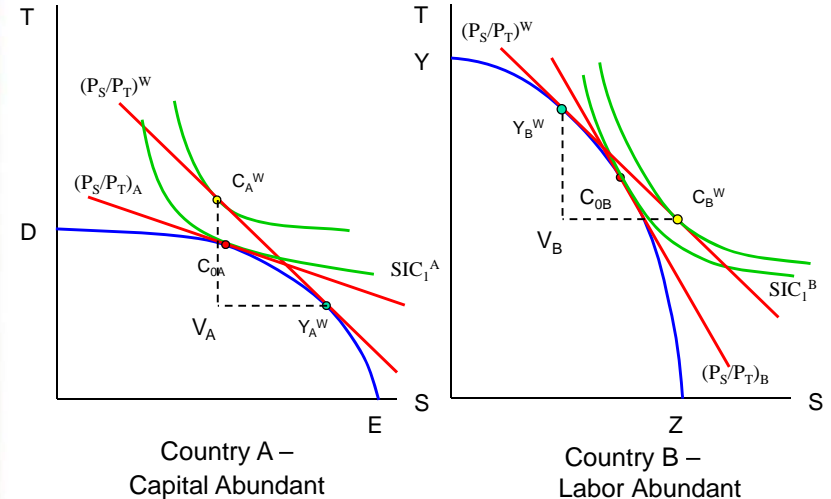
- If TOT rises to $(P_S/P_T)_2$:
 - Production: Y_2
 - Consumption: C_2
- Country A's Trade triangle is larger!
- Question: When will TOT stop rising? ...

Country A – Capital Abundant

Note: These lecture notes are incomplete without having attended lectures



Trade Equilibrium in HO Model (cont.)



Country A – Capital Abundant

Country B – Labor Abundant

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Trade Equilibrium in HO Model

Note:

- At any point in time, only one price will prevail in the market.
- The world (relative) price, or Terms of trade, are determined by reciprocal demand and lie between the two countries' pre-trade price ratios
 - Trade triangle will be congruent in both countries!
- Equilibrium production with trade exhibits incomplete specialization (due to increasing opportunity cost)
- Equilibrium consumption with trade implies a rise in standard of living

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Differences between Classical and HO Models

- Complete specialization results in classical model, while **incomplete specialization occurs in HO model**.
- In classical model, only demand conditions affect reciprocal demand. **In HO model, reciprocal demand leads to equilibrium price via changes in both demand and supply.**
- Autarky price in the classical model is determined only by supply conditions. **In HO model, demand and supply determine autarky price.**

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Extensions of the HO Theorem

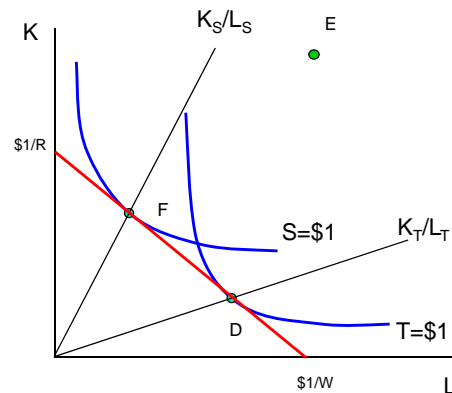
- Rybczynski Theorem
- Factor Price Equalization Theorem
- Stolper-Samuelson Theorem

Rybczynski Theorem

- **Rybczynski Theorem:** At constant world prices, if a country experiences an increase in the supply of one factor, it will produce more of the product intensive in that factor and less of the other.

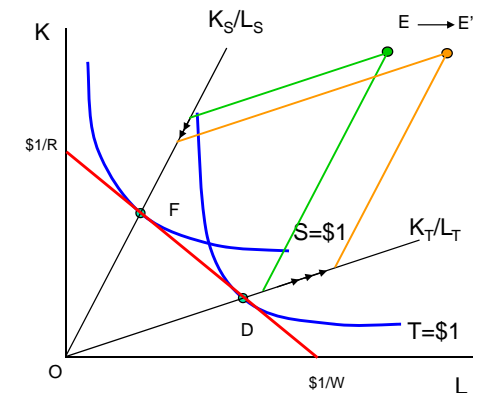
Proof of Rybczynski Theorem

- As before, suppose that: $P_S/P_T=1$
- If W and R are held fixed, then CRS means rays of origin through F and D are optimal capital/labor ratios
- Suppose E represents initial endowment of K and L in the economy



Proof of Rybczynski Theorem

- How does economy divide up resources of K and L ?
 - Complete the parallelogram from E to the two rays!
- Now, suppose the country's endowment of labor rises (K and prices remain the same)... what happens?



Factor Price Equalization Theorem

- **Factor Price Equalization Theorem:** Given all the assumptions of the HO model, free international trade will lead to the international equalization of individual factor prices
 - i.e. $W_A = W_B = W^*$ and $R_A = R_B = R^*$

Factor Price Equalization Theorem

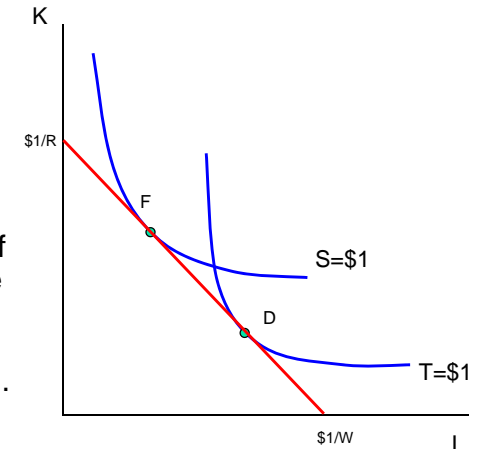
- Country A is relatively capital-abundant and rent is low.
 - With trade, the increase in demand for capital for producing exports raises rent.
- Country B is relatively labor-abundant and wages are low
 - With trade the increase in the demand for labor for producing exports raises wages.

Stolper-Samuelson Theorem

- **Stolper-Samuelson Theorem:** An increase in the price of a consumption good leads to an increase in the return to the factor in which that good is intensive and a decline in the return of the other factor
 - i.e. Free international trade benefits the abundant factor and harms the scarce factor.

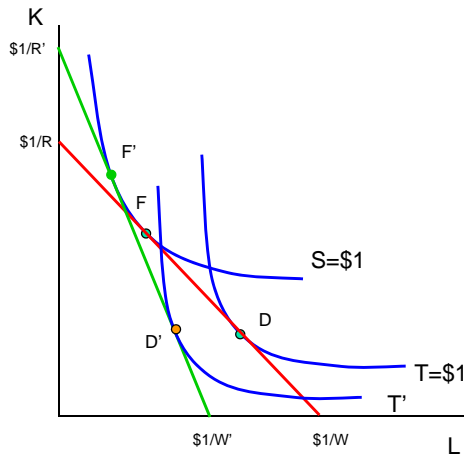
Proof of Stolper-Samuelson Theorem

- Points D and F represent optimal input allocations for \$1 of output of each good
- Suppose the price of T rises (because the country begins to engage in international trade)...
- ... what happens?



Proof of Stolper-Samuelson Theorem

- At a higher price for T, \$1 worth of T will lie on a lower isoquant (T')
- If some of both goods are to be produced, the \$1 isocost line has to rotate (in order to maintain tangency)
 - Wages and Rent change

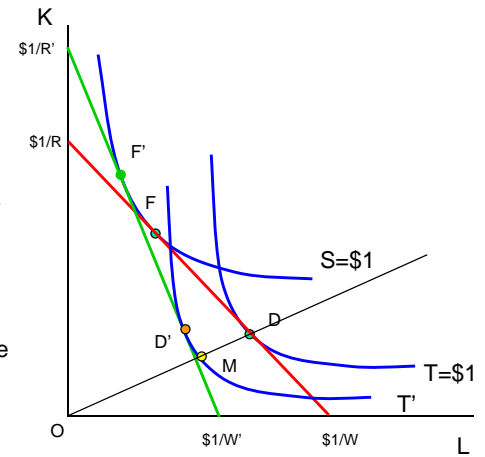


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Proof of Stolper-Samuelson Theorem

- Thus, R falls whilst W is higher!
- Since P_S has not changed, purchasing power of capital has declined
- A rise in W means labor can afford to purchase more S and more T!
 - For T: graphically this can be seen by comparing the increase in W [i.e. $(1/W)/(1/W')$] to proportionate increase in price of T [i.e. OD/OM].



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Implications of Stolper-Samuelson Theorem

- Some groups in society will oppose international trade.
- Scarce factors will lobby government for trade protection.
- Even though some in society lose, the country overall benefits from international trade relative to autarky.
- A system of taxation and transfers could be developed to compensate the losers while leaving the gainers better off relative to autarky.

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