International Economics I

The Heckscher-Ohlin Model

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Introduction

- In the neoclassical frameworks, there is trade when there is **comparative advantage**.
- Technological differences across countries $\Rightarrow$ The Ricardian model.
- Differences in factor endowments (capital, labor, land,...): $\Rightarrow$ Heckscher-Ohlin model.
  - e.g., the US import lumber from Canada since Canada has more land per capita than the US
- In the Heckscher-Ohlin model, a country's comparative advantage depends on:
  - its relative factor abundance combined with
  - its relative intensity in factor utilization for the production of different goods.

Introduction

- We will study how differences in resources (factors) generate a specific pattern of trade.
- In many dimensions the HO model is very similar to the Specific Factor Model. One crucial difference:
  - Specific Factors $\Rightarrow$ Only one mobile factor, others are fixed (short run)
  - HO $\Rightarrow$ All factors are mobile across sectors (long run).

Also useful to:

- Understand how trade may affect inequality even in the long run.
- What happens if the endowment of a factor changes?

Relative Endowments (K/L) Across Countries

Are endowments different across countries?

Capital and Labor endowments, 1996

Country	Labor force (mln)	Capital Stock ($bln)	Capital per worker ($)
India	369.50	2,080	5,629
China	735.10	5,450	7,414
Chile	5.57	204	36,653
Brazil	59.13	2,280	38,560
Mexico	31.67	1,400	44,211
Argentina	14.62	719	49,192
UK	29.05	2,550	87,778
Korea	18.97	1,860	98,055
Spain	15.63	1,720	110,024
Canada	15.12	1,850	122,326
US	135.40	17,000	125,554
Japan	79.73	10,600	132,953
Switzerland	3.92	621	158,504

Factor Intensities Across Sectors

Are factor intensities different across sectors?

Capital-Labor Ratio by Selected US Industries, 2005

INDUSTRY	Labor (th)	Capital Stock ($ mln)	Capital per worker ($ th)
APPAREL AND TEXTILES	262	15821	60.362
FURNITURE AND FIXTURES	324	20241	62.569
LUMBER AND WOOD PRODUCTS	535	35961	67.242
LEATHER AND LEATHER PRODUCTS	27	1944	71.482
PRINTING AND PUBLISHING	436	43529	99.953
FABRICATED METAL PRODUCTS	939	114058	121.520
RUBBER AND PLASTICS	673	91080	135.255
FOOD AND KINDRED PRODUCTS	1123	193020	171.848
TRANSPORTATION EQUIPMENT	881	185904	211.110
INSTRUMENTS AND RELATED PRODUCTS	320	67490	211.169
PRIMARY METAL INDUSTRIES	380	112946	297.304
PAPER AND ALLIED PRODUCTS	371	110728	298.297
ELECTRONIC AND ELECTRIC EQUIPMENT	591	199212	337.133
CHEMICALS	406	225141	554.261
PETROLEUM AND COAL PRODUCTS	64	91294	1424.242

Outline

The Heckscher-Ohlin Model: 2x2x2

- 2 countries: home and foreign (denote variables of foreign with *).
  - Same preferences.
- 2 goods: Textiles (T) and Automobiles (A).
  - Same technology to produce each good in both countries.
  - T uses labor more intensively than A.
- 2 factors of production: Labor (L) and Capital (K)
  - Mobile between sectors, not between countries.
  - Different relative endowments of labor.
    - ⋆ e.g., Home has relative abundance of L ($L/K > L^*/K^*$)

The Heckscher-Ohlin Model: 2x2x2

- Define the relative demand and relative supply and find the equilibrium in a closed economy.
- Study the implications of changes in the endowments $(K,\ L)$ on prices.
- Open the economy to trade!
- We will now assume our economy is large and changes in the domestic supply and demand potentially affects the international price.

Preferences and Relative Demand

- Standard utility with the usual assumptions $\Rightarrow$ increasing in both goods, homogenous of degree one.
- **Identical** in both countries.
- Income of representative consumer: $rK + wL$ (i.e. factor payment).
- Assume that consumer spends a fraction b of her income in good T, and $(1-b)$ in good A.

$$P_T D_T = b(rK + wL) \quad \& \quad P_A D_A = (1-b)(rK + wL)$$

- Combining both we get the relative demand:

$$\frac{D_T}{D_A} = \frac{b}{1-b}\frac{P_A}{P_T}$$

Production and Relative Supply

- Production is carried by combining both inputs K and L using a technology (a production function):

$$Q_T = F_T(K_T, L_T) \qquad \& \qquad Q_A = F_T(K_A, L_A)$$

- where K_T and L_T are the quantities of capital and labor in the T sector, while K_A and L_A are the quantities of capital and labor in the A sector.
- There is some degree of substitution between inputs.
  - I can always use some workers instead of a machine.
- Given the total quantities of capital and labor, the resource constraint of the economy is:

$$K = K_T + K_A \qquad \& \qquad L = L_T + L_A$$

Production

- How firms much of each input the firms decide to use? Recall that firms maximize profits given factor and goods prices, w, r and p_i:

$$\max_{L_i,K_i} \pi_i = p_i F_i(L_i, K_i) - wL_i - rK_i \qquad \text{for } i = T, A \tag{1}$$

- Taking derivatives with respect to L_i and K_i and equalizing to zero:

$$p_i \underbrace{\frac{\partial F_i(L_i, K_i)}{\partial L_i}}_{MPL_i} = w \qquad \text{and} \qquad p_i \underbrace{\frac{\partial F_i(L_i, K_i)}{\partial K_i}}_{MPK_i} = r \tag{2}$$

Production

- Combining the two optimality conditions:

$$\frac{MPL_i}{MPK_i} = \frac{w}{r} \qquad \text{for } i = T, A \tag{3}$$

- Because of factor mobility, factor prices (r, w) are the same in both sectors! But the MPL and MPK are **not** the same in both sectors!
- This means that the labor-capital, L/K, ratio depends on the cost of labor relative to capital w/r.
- If the cost of labor is relatively higher: $\uparrow w/r$, firms will substitute labor for capital: $\downarrow L/K$.

Technology and Factor Intensities

- We say that the production function has the following factor requirements:

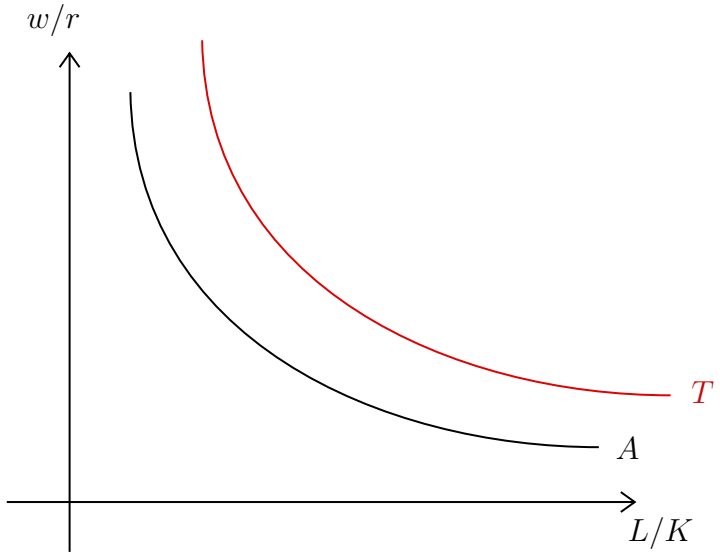
$$\begin{aligned} a_{KT} &= \text{capital used for 1 unit of } T \rightarrow Q_T = K_T/a_{KT} \\ a_{LT} &= \text{labor used for 1 unit of } T \rightarrow Q_T = L_T/a_{LT} \\ a_{KA} &= \text{capital used for 1 unit of } A \rightarrow Q_A = K_A/a_{KA} \\ a_{LA} &= \text{labor used for 1 unit of } A \rightarrow Q_A = L_A/a_{LA} \end{aligned}$$

  - a_{Ki} and a_{Li} are unit factor demands and in general depend on factor prices, (w and r). For now, we consider them constant and exogenous.
- A and T differ in their relative factor intensity:

$$\frac{a_{LT}}{a_{KT}} > \frac{a_{LA}}{a_{KA}}$$

  - T is relatively intensive in L (labor intensive).

Production



Equilibrium in Closed Economy

- In closed economy, $RD(= D_T/D_A) = RS$:

$$\frac{D_T}{D_A} = \frac{b}{1-b}\frac{P_A}{P_T} = \frac{Q_T}{Q_A}$$

- Production of A and T has to achieve full employment of L and K

$$\begin{aligned} L = \quad L_T + L_A = \quad a_{LT} \times Q_T + a_{LA} \times Q_A \\ K = \quad K_T + K_A = \quad a_{KT} \times Q_T + a_{KA} \times Q_A \end{aligned}$$

- We can use these two equations to derive the relative supply, Q_T/Q_A!

Equilibrium in Closed Economy

- to obtain Q_A and Q_T
  - solve the 2×2 system for factor market clearing:

$$\begin{cases} Q_A = \frac{K - a_{KT} \times Q_T}{a_{KA}} \\ L = a_{LT} \times Q_T + a_{LA} \times Q_A \end{cases} \rightarrow \begin{cases} Q_A = \frac{K}{a_{KA}} - \frac{a_{KT}}{a_{KA}} \times Q_T \\ Q_T = \frac{L}{a_{LT}} - \frac{a_{LA}}{a_{LT}} \times Q_A \end{cases}$$

$$\begin{aligned} Q_A &= \frac{K}{a_{KA}} - \frac{a_{KT}}{a_{KA}} \frac{L}{a_{LT}} + \frac{a_{KT}}{a_{KA}} \frac{a_{LA}}{a_{LT}} Q_A \\ \frac{a_{KA}a_{LT} - a_{LA}a_{KT}}{a_{KA}a_{LT}} Q_A &= \frac{K}{a_{KA}} - \frac{a_{KT}}{a_{KA}} \frac{L}{a_{LT}} \end{aligned}$$

$$\Rightarrow \begin{cases} Q_T = \frac{a_{KA}L - a_{LA}K}{a_{KA}a_{LT} - a_{LA}a_{KT}} \\ Q_A = \frac{a_{LT}K - a_{KT}L}{a_{KA}a_{LT} - a_{LA}a_{KT}} \end{cases}$$

  - Which deliver the relative supply: RS:

$$\frac{Q_T}{Q_A} = \frac{a_{KA}L - a_{LA}K}{a_{LT}K - a_{KT}L}$$

Equilibrium Production

$$Q_T = \frac{a_{KA}L - a_{LA}K}{a_{KA}a_{LT} - a_{LA}a_{KT}} \quad \text{and} \quad Q_A = \frac{a_{LT}K - a_{KT}L}{a_{KA}a_{LT} - a_{LA}a_{KT}}$$

- For home to produce both goods, two conditions are required:
  - (i) different factor intensities across sectors

$$a_{KA}a_{LT} - a_{LA}a_{KT} > 0 \Leftrightarrow a_{LA}/a_{KA} < a_{LT}/a_{KT}$$

  - (ii) Relative labor endowment within the "cone of diversification"

$$Q_A > 0 \Leftrightarrow a_{LT}K - a_{KT}L > 0 \Leftrightarrow L/K < a_{LT}/a_{KT}$$
$$Q_T > 0 \Leftrightarrow a_{KA}L - a_{LA}K > 0 \Leftrightarrow L/K > a_{LA}/a_{KA}$$

    i.e., lying between the relative labor intensities of both goods

Equilibrium Production: Properties

$$Q_T = \frac{a_{KA}L - a_{LA}K}{a_{KA}a_{LT} - a_{LA}a_{KT}} \quad \text{and} \quad Q_A = \frac{a_{LT}K - a_{KT}L}{a_{KA}a_{LT} - a_{LA}a_{KT}}$$

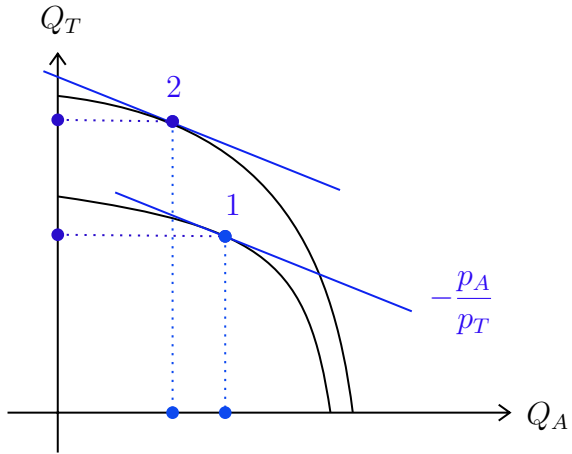
- production of the L-intensive good (Q_T) is increasing in the relative endowment of L : $\uparrow L/K \rightarrow \uparrow Q_T$
- production of the K-intensive good (Q_A) is increasing in the relative endowment of K: $\downarrow L/K \rightarrow \uparrow Q_A$

Rybczynski effect:

- *an increase in the endowment of a factor (e.g., L) raises disproportionately the production of the good intensive in that factor (Q_T)*

$$\%\Delta Q_T > \%\Delta L > 0 > \%\Delta Q_A$$

Rybczynski effect



Intuition: to absorb ΔL in the production of T, need to employ also more $K \rightarrow$ move some K and L away from A

Equilibrium in Closed Economy: Relative Price

- to obtain the relative price (P_T/P_A)
  - replace the RS into the good market clearing condition

$$\frac{D_T}{D_A} = \frac{1-b}{b}\frac{P_A}{P_T} = \frac{Q_T}{Q_A} = \frac{a_{KA}L - a_{LA}K}{a_{LT}K - a_{KT}L}$$

  - and simplify...

$$\frac{P_T}{P_A} = \frac{b}{1-b}\frac{a_{LT}K - a_{KT}L}{a_{KA}L - a_{LA}K} = \frac{b}{1-b}\frac{a_{LT}\frac{K}{K} - a_{KT}\frac{L}{K}}{a_{KA}\frac{L}{K} - a_{LA}\frac{K}{K}}$$

  ...to get

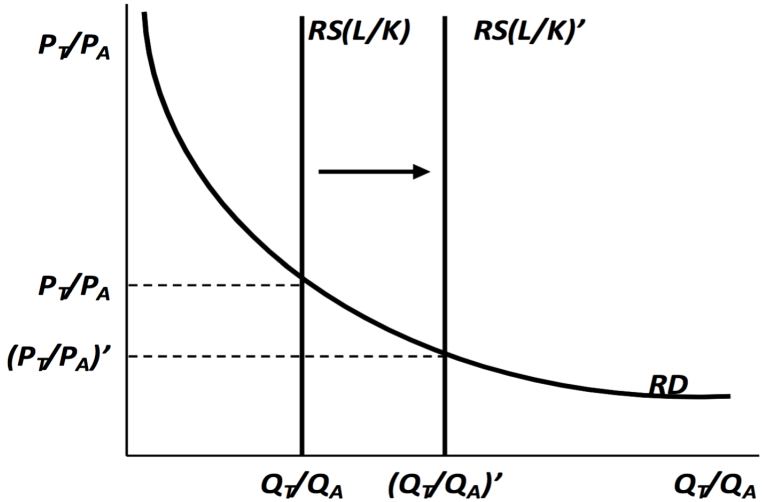
$$\frac{P_T}{P_A} = \frac{b}{1-b}\frac{a_{LT} - a_{KT}\frac{L}{K}}{a_{KA}\frac{L}{K} - a_{LA}}$$

Equilibrium Relative Price: Properties

$$\frac{P_T}{P_A} = \frac{b}{1-b}\frac{a_{LT} - a_{KT}\frac{L}{K}}{a_{KA}\frac{L}{K} - a_{LA}}$$

- P_T/P_A is a decreasing function of L/K
  - the relative price of a good is decreasing in the relative endowment of the factor it uses intensively
  - intuition: more $L/K \rightarrow$ more Q_T/Q_A (RS) $\rightarrow$ lower P_T/P_A
- relative endowments $\rightarrow$ relative price $\rightarrow$ comparative advantage
  - in K-abundant countries, the K-intensive good is cheaper
  - in L-abundant countries, the L-intensive good is cheaper

Equilibrium in Closed Economy: Graph



Factor Prices

- What about factor prices? $r,\ w$?
- Perfect-competition pricing (price = marginal cost):

$$\begin{aligned} P_T &= a_{KT} \times r + a_{LT} \times w \\ P_A &= a_{KA} \times r + a_{LA} \times w \end{aligned}$$

- Intuitively, if T becomes relatively more expensive, $\uparrow P_T/P_A$,
  - Increasing production of T.
  - Increases the demand for L relatively more than K.
  - The price of L increases relatively more than $K \Rightarrow \uparrow w/r$.

Factor Prices

- Analytically, to obtain factor prices (w and r)
  - solve, for given P_T and P_A, the system:

$$\begin{cases} P_T = a_{KT} \times r + a_{LT} \times w \\ P_A = a_{KA} \times r + a_{LA} \times w \end{cases} \rightarrow \begin{cases} w = \frac{1}{a_{LT}} P_T - \frac{a_{KT}}{a_{LT}} r \\ r = \frac{1}{a_{KA}} P_A - \frac{a_{LA}}{a_{KA}} w \end{cases}$$

$$r \left(\frac{a_{KA}a_{LT} - a_{LA}a_{KT}}{a_{KA}a_{LT}} \right) = \frac{1}{a_{KA}} P_A - \frac{a_{LA}}{a_{KA}a_{LT}} P_T$$

$$w = \frac{a_{KA}P_T - a_{KT}P_A}{a_{LT}a_{KA} - a_{KT}a_{LA}} \quad \text{and} \quad r = \frac{P_A a_{LT} - a_{LA}P_T}{a_{LT}a_{KA} - a_{KT}a_{LA}}$$

Relative Factor Prices: Properties

- The price of a factor:

$$w = \frac{a_{KA}P_T - a_{KT}P_A}{a_{LT}a_{KA} - a_{KT}a_{LA}} \quad \text{and} \quad r = \frac{P_A a_{LT} - a_{LA}P_T}{a_{LT}a_{KA} - a_{KT}a_{LA}}$$

  - is increasing in the price of the good intensive in that factor (w of P_T, r of P_A)
  - is decreasing in the price of the other good (w of P_A, r of P_T)

- The relative price of a factor

$$\frac{w}{r} = \frac{a_{KA}\frac{P_T}{P_A} - a_{KT}}{a_{LT} - a_{LA}\frac{P_T}{P_A}}$$

  - is increasing in the relative price of the good intensive in that factor

Relative Factor Prices: Properties

- **Stolper-Samuelson** effect:
  - *an increase in the price of a good (e.g., P_T) increases more than proportionally the price (w) of the factor it uses intensively (L)*

$$\%\Delta w > \%\Delta P_T > 0 > \%\Delta r$$

- if the relative endowment of a factor increases (e.g., L/K):
  - the relative price of the good that uses it intensively falls ($L/K \uparrow \rightarrow P_T/P_A \downarrow$)
  - the relative price of that factor fall ($P_T/P_A \downarrow \rightarrow w/r \downarrow$)

Equilibrium in Closed Economy: Summary

- Supply of Q_T and Q_A:

$$Q_T = \frac{a_{KA}L - a_{LA}K}{a_{KA}a_{LT} - a_{LA}a_{KT}} \quad Q_A = \frac{a_{LT}K - a_{KT}L}{a_{KA}a_{LT} - a_{LA}a_{KT}}$$

- Relative supply, RS, is:

$$\frac{Q_T}{Q_A} = \frac{a_{KA}L - a_{LA}K}{a_{LT}K - a_{KT}L}$$

- Relative price of goods

$$\frac{P_T}{P_A} = \frac{b}{1-b}\frac{a_{LT} - a_{KT}\frac{L}{K}}{a_{KA}\frac{L}{K} - a_{LA}}$$

- Relative price of factors

$$\frac{w}{r} = \frac{a_{KA}\frac{P_T}{P_A} - a_{KT}}{a_{LT} - a_{LA}\frac{P_T}{P_A}}$$

Outline

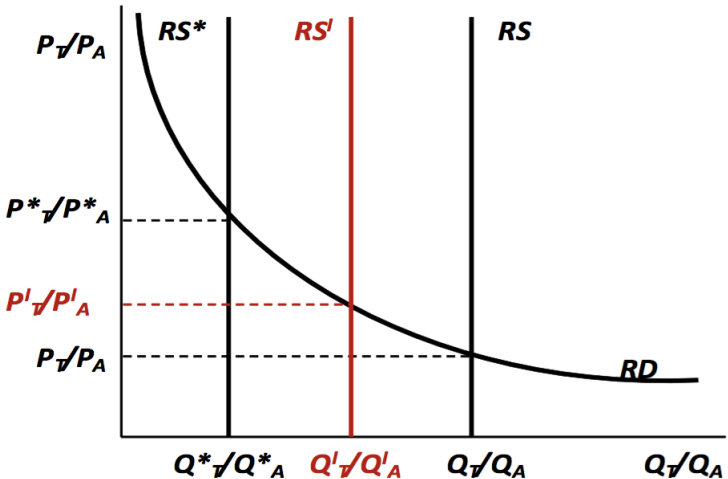
Open Economy

- Consider 2 large economies: home and foreign $(^*)$.
- Same tastes $\rightarrow$ RD=RD*.
- Same technology + different relative endowments
  - Suppose $a_{LT}/a_{KT} > L/K > L^*/K^* > a_{LA}/a_{KA}$.
  - A and T produced in both countries.
  - Home is relatively L-abundant.
- In closed economy:
  - $RS > RS^* : L/K > L^*/K^* \Rightarrow \ Q_T/Q_A > Q_T^*/Q_A^*$
  - $Q_T/Q_A > Q_T^*/Q_A^* \rightarrow P_T/P_A < P_T^*/P_A^*$
- Home has a comparative advantage in T, Foreign has a comparative advantage in A.

Equilibrium in Open Economy

- Open to trade leads to price convergence:
  - The price of both goods has to be equal to the international (^{I}) price in both countries:
$$P_T = P_T^* = P_T^I \quad \text{and} \quad P_A = P_A^* = P_A^I$$
  - the international goods market has to clear
$$\frac{1-b}{b}\frac{P_T^I}{P_A^I} = \frac{Q_A + Q_A^*}{Q_T + Q_T^*}$$
  - Given that $Q_T/Q_A > Q_T^*/Q_A^*$, the equilibrium relative price will lie between the closed-economy ones
$$P_T/P_A < P_T^I/P_A^I < P_T^*/P_A^*$$

Equilibrium in Open Economy: Graph



Equilibrium in Open Economy: Pattern of Trade

- the equilibrium relative price implies that:
  - for home, T becomes relatively more expensive $\rightarrow$ home comparative advantage
  - for foreign, A becomes relatively more expensive $\rightarrow$ foreign comparative advantage
- equilibrium relative demand implies that:
  - in both countries, relative demand of T is higher than RS* and lower than RS
  - home exports T and imports A, foreign the other way around
- **Heckscher-Ohlin Theorem**:
  - in open economy, provided that no perfect specialization occurs, a country exports the good intensive in its relatively abundant factor
- **Gains From Trade**: Both countries gain! Terms of Trade increase for both countries.

Equilibrium in Open Economy: Factor Prices

- If both countries produce both goods, factor price equation must hold in both countries:

$$\frac{w}{r} = \frac{a_{KA}P_T^I/P_A^I - a_{KT}}{a_{LT} - a_{LA}P_T^I/P_A^I} \tag{4}$$

- International prices is the same in both countries (P_T^I/P_A^I).
- Since we assume that technologies are the same (the "a's "). $\Rightarrow$ Factor prices should equalize across countries!

$$w = w^* = w^I \quad \text{and} \quad r = r^* = r^I$$

- Important result: **Factor price equalization**!
  - If no barriers to trade, technologies are the same in both countries, and there is no complete specialization: factor prices equalize!

Factor Prices and Income Distribution

- Consequences for income distribution:
  - **Home:** the increase in the relative price of T in home makes L gain relative to K.

$$P_T^I/P_A^I > P_T/P_A \rightarrow w^I/r^I > w/r$$

  - **Foreign:** the increase in the relative price of A in foreign makes K^* gain relative to L^*

$$P_T^I/P_A^I < P_T^*/P_A^* \rightarrow w^I/r^I < w/r$$

- Trade benefits the abundant factor and hurts the scarce factor.

Outline

Application: Immigration to K-Abundant

- What happens when factor endowments change? Study a particular type of labor change: immigration!
- Immigration from a third country into the foreign country:
  - $L^*/K^* \uparrow \longrightarrow Q_T^*/Q_A^* \uparrow \longrightarrow P_T^*/P_A^* \downarrow \rightarrow P_T^I/P_A^I \downarrow \rightarrow w^I/r^I \downarrow$
  - comparative advantage is weakened in both countries
  - less trade
  - lose part of the GFT
  - workers lose and capitalists gain.

Application: Immigration to L-Abundant

- immigration from a third country into the home country:
  - $L/K \uparrow \longrightarrow Q_T/Q_A \uparrow \longrightarrow P_T/P_A \downarrow \rightarrow P_T^I/P_A^I \downarrow \rightarrow w^I/r^I \downarrow$
  - comparative advantage is reinforced in both countries
  - more trade
  - larger GFT
  - workers lose relative to capitalists

Application: Migration from L to K-Abundant

- Consider migration from the home to the foreign country:
  - $L^*/K^* \uparrow \longrightarrow Q_T^*/Q_A^* \uparrow$ and $L/K \downarrow \longrightarrow Q_T/Q_A \downarrow$
  - $(L + L^*)\,/\,(K + K^*)$ unchanged $\longrightarrow$ Q_T^I/Q_A^I unchanged
  - comparative advantage is weakened in both countries
  - less trade
  - smaller GFT
  - no efect on P_T^I/P_A^I and w^I/r^I since RS^I unchanged

Application: Migration from K to L-Abundant

- Consider migration from the foreign to the home country:
  - $L^*/K^* \downarrow \longrightarrow Q_T^*/Q_A^* \downarrow$ y $L/K \uparrow \longrightarrow Q_T/Q_A \uparrow$
  - $(L + L^*)\,/\,(K + K^*)$ unchanged $\longrightarrow$ Q_T^I/Q_A^I unchanged
  - comparative advantage is reinforced in both countries ($\rightarrow$ more trade)
  - more trade
  - larger GFT
  - no efect on P_T^I/P_A^I and w^I/r^I since RS^I unchanged

Application: Trade and the Skill Premium

- Focus on one particular type of inequality within a country:
  - Difference between the wage of different types of workers: skilled H and unskilled L.
  - Skill premium: wage gap between skilled and unskilled: W_s/W_L.
- Rise in wage inequality and skill premium worldwide in the last 40 years.
- Possible determinants:
  - drop in relative supply of skilled labor worldwide
  - trade
  - technological change.

Application: Trade and the Skill Premium

- Let's focus on the US-Mexico case.
- Let's assume technology is the same in both countries
  - 2 factors: High-skilled labor (H) and low-skilled labor (L)
  - 2 goods: textiles (intensive in L) and PCs (intensive in H)
  - H relatively more abundant in the US:

$$\frac{H^{USA}}{L^{USA}} > \frac{H^{MEX}}{L^{MEX}} \tag{5}$$

- Let's assume that $W_H > W_L$ in both countries.

Application: Trade and the Skill Premium

- Applying the theoretical results we have learned in class:
  - US exports PCs and imports textiles
  - Mexico exports textiles and imports PCs
- What happens when US and Mexico start increasing trade?
  - In the US:
    - The relative price of PCs goes up
    - The relative remuneration of H goes up $\frac{W_H}{W_L} \uparrow \Rightarrow$ skill-premium increases $\Rightarrow$ inequality increases
  - In Mexico
    - The relative price of PCs goes down
    - The relative remuneration of H goes down $\frac{W_H}{W_L} \downarrow \Rightarrow$ skill-premium decreases $\Rightarrow$ inequality decreases

Application: Trade and the Skill Premium

What do we see in the data?

- Skill-premium has increased in the US
- Skill-premium has **ALSO** increased in the Mexico
- The basic HO model fails for Mexico.
- It should be something else!

Application: Trade and the Skill Premium

- **Possible explanation:** Skill-biased technological change.
  - This means that H has become more and more productive over time in both countries.
  - This would imply a higher demand for H relative to L in both countries
  - Skill-premium increases because of changes in technology: $\uparrow w_H/w_L$.
- Evidence in favor of this argument: production in the US has become more intensive in H in ALL sectors,

Outline

Empirical Evidence

- The essence of the HO model is that trade is driven by **differences in factor abundance** across countries.
- In HO model: goods trade is a substitute for factor trade.
- To test the predictions of the model, we should look at the factor content of the goods traded.
- If many goods, factors and countries:
  - difficulty: which good is intensive in which factor?
  - difficulty: factor abundance relative to which other factor?

Empirical Evidence

- Leontieff (1953) was the first to confront the HO model with data.
- The US had much more capital per worker than the other countries.
- However, US exports are much more labor-intense than its imports! $\Rightarrow$ **Leontieff paradox**.
- Many explanations for these results:
  - US and foreign technology are not the same.
  - Ignored land, a very important input.
  - Labor should have been disaggregated by skill.
  - The US was not engaged in free trade, as the HO model assumes.
- Leamer's critique (1980) $\rightarrow$ we should not look at L/K of exports/imports, but to the net factor content of all trade instead.

Many Goods, Factors and Countries

- Alternative version of the HO: The HO-Vanek model.
  - net factor f content of c's trade = factor f endowment - factor f demand
    - ⋆ V_c^f and V_w^f= country c and world (w) endowment of factor f
    - ⋆ s_c = country c share in world income $\rightarrow$ demand of $f = s_c V_w^f$
    - ⋆ F_c^f = net factor f content of c's trade

$$F_c^f = V_c^f - s_c V_w^f \Rightarrow \frac{F_c^f}{V_w^f} = \frac{V_c^f}{V_w^f} - s_c$$

  - Provided that no perfect specialization occurs, a country is net exporter of the services of its abundant factor and net importer of its scarce factor.

Empirical Evidence: Factor Content of Trade

- Bowen et al. (1987) consider 27 countries and their endowment of 12 factors.
- Suppose country c has
  - endowment of factor j equal to 10% of world endowment of j ($V_c^j / V_W^j = 0.1$)
  - endowment of factor h equal to 2% of world endowment of h ($V_c^h / V_W^h = 0.02$)
  - a GDP equal to 5% of world GDP ($s_c = 0.05$)
- HO-Vanek predicts
  - c net exporter of j (5% of world endowment of j)
  - c net importer of factor h (3% of world endowment of h)
- Count for how many countries the net export of each factor follows the predicted pattern.

Empirical Evidence: Factor Content of Trade (III)

- Trefler (1995) poited out that HO also predict the volume of net factor export.
- the US had
  - 23% of world GDP
  - 5% of world workers
  - should import 4 times as many workers (18% of the world).
- In general: there is very little factor trade compared to HO predictions (the "missing trade").
- Davis and Weinstein (2001): HO works if you add
  - different technology (factor productivity)
  - no factor price equalization across countries
  - non-traded goods + trade costs

Empirical Evidence: Patterns of Export to the US

- Romalis (2004) shows the validity of a "quasi-H-O" prediction:

  "countries abundant in skilled labor and capital capture a higher share of US imports in sectors intensive in those factors"

- intuition: given the set of exporters to a certain destination (the US),
  - skill-abundant countries are "better" at exporting skill-intensive goods
  - hence capture a higher import share the higher the skill intensity of the good
- advantages:
  - no need to assume same technology and factor price equalization
  - use high-quality and homogeneous data
- this prediction is supported by data on:
  - US import and technology for 370 sectors
  - factor endowments of 123 exporting countries

Taking Stock

- The evidence in favor of the HO is mixed.
  - Trade in goods does not necessarily reflect trade in factors.
  - Volume of trade is substantially lower than predicted.
- Main missing point: technological differences across countries.
- The "main pattern of trade" between developed and developing are well reflected in the HO model:
  - e.g. Vietnam exports $L - intensive$ goods and Germany $K - intensive$ goods.