Lecture 2: The neo-classical model of international trade

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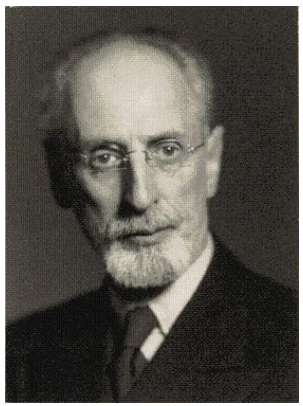
Class Overview

1. The HOS model
2. Openness and income inequalities : the Stolper-Samuelson theorem
3. The role of factor endowments : the Rybczynski theorem
4. The Leontieff paradox



Eli Heckscher
(1879-1952)
The Effect of Foreign Trade on the Distribution of Income, 1919

Bertil Ohlin
(1899-1979)
Interregional and International Trade, 1933

Paul Samuelson
(1915-)
Foundations of Economics Analysis, 1947

The HOS Model

Overview

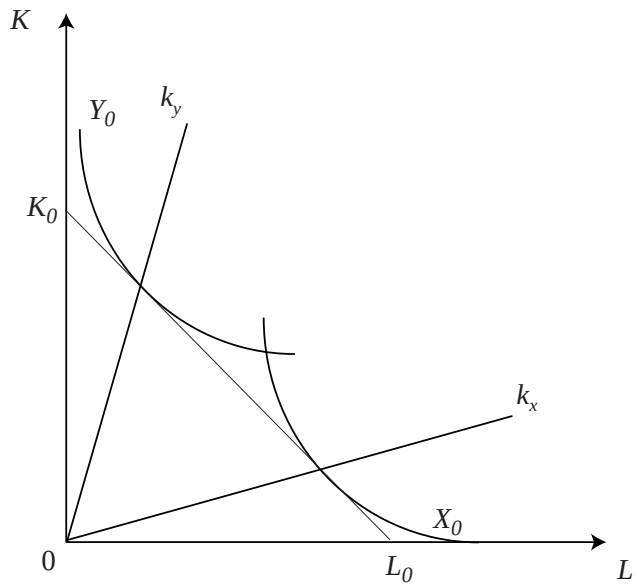
- **Assumptions**
  - 2 countries, 2 goods, 2 production factors ($2 \times 2 \times 2$)
  - Factors are mobile across sectors but immobile across countries
  - Free trade, no transportation costs
- **Results**
  - Origin of comparative advantages
  - Specialization raises social welfare but unequally across individuals

The Model

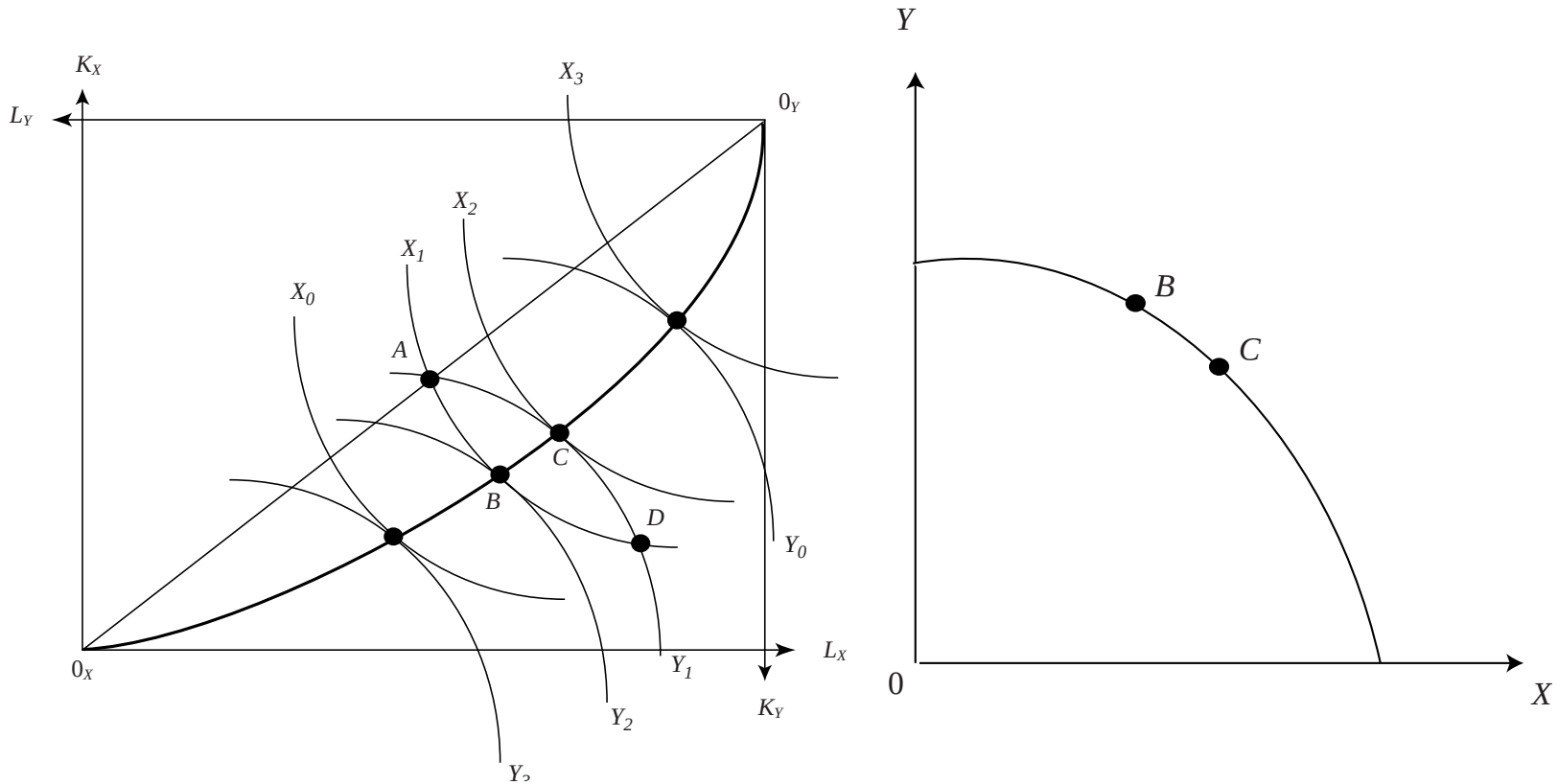
- 2 countries : Home and Foreign (*)
- 2 goods : X (labor intensive), Y (capital intensive)
- 2 factors : K, L, mobile across sectors (hence same factor prices)
- Technical coefficients L/Y, K/Y depend on relative factor prices w/r (substitutability)
- Same production functions in both countries
- Home relatively richer in capital than in labor, compared to Foreign : $(K/L) > (K^*/L^*)$
- Equilibrium of factor markets :
  Labor : $L_X + L_Y = L$
  Capital : $K_X + K_Y = K$
  Same in the foreign country (K^*, L^*)
- Perfect competition
  $\rightarrow$ Zero profit in equilibrium
- Budget constraint :
  $Y = wL + rK$

Factor intensity

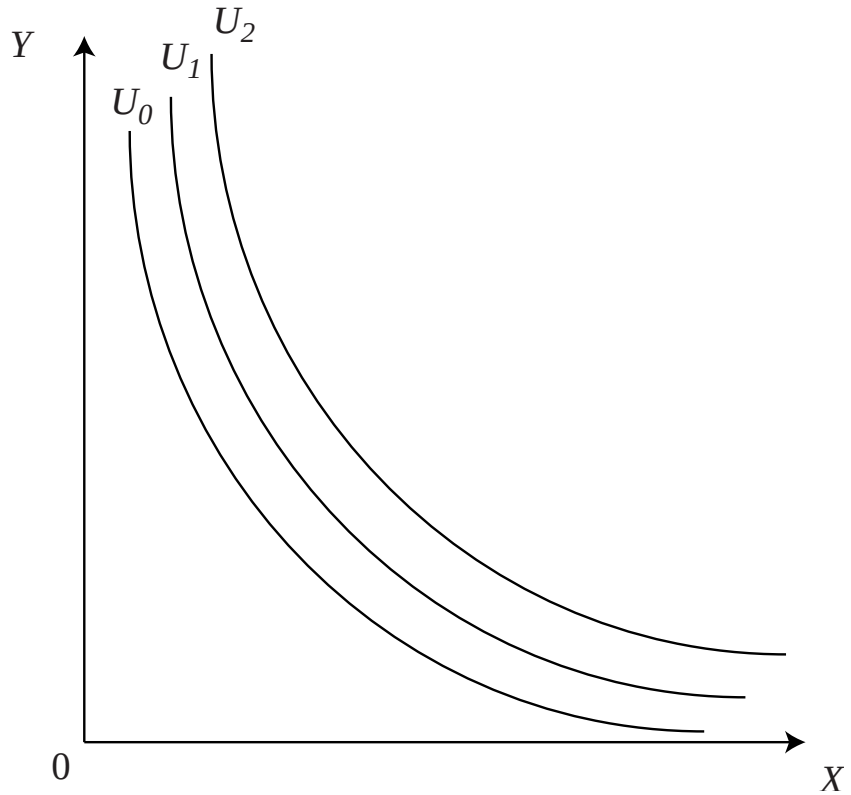
- 2 goods : $X = F_X(L_X, K_X)$ and $Y = F_Y(L_Y, K_Y)$
- X is relatively labor intensive : $\frac{K_Y}{L_Y} > \frac{K_X}{Y_X}$
- Isoquant : Combinations of L and K that give the same quantity of output
- At the firm's optimum, marginal rate of transformation = relative price of factors
- Mobility of factors across sectors $\longrightarrow$ MRT equalized



Edgeworth box and the PPF

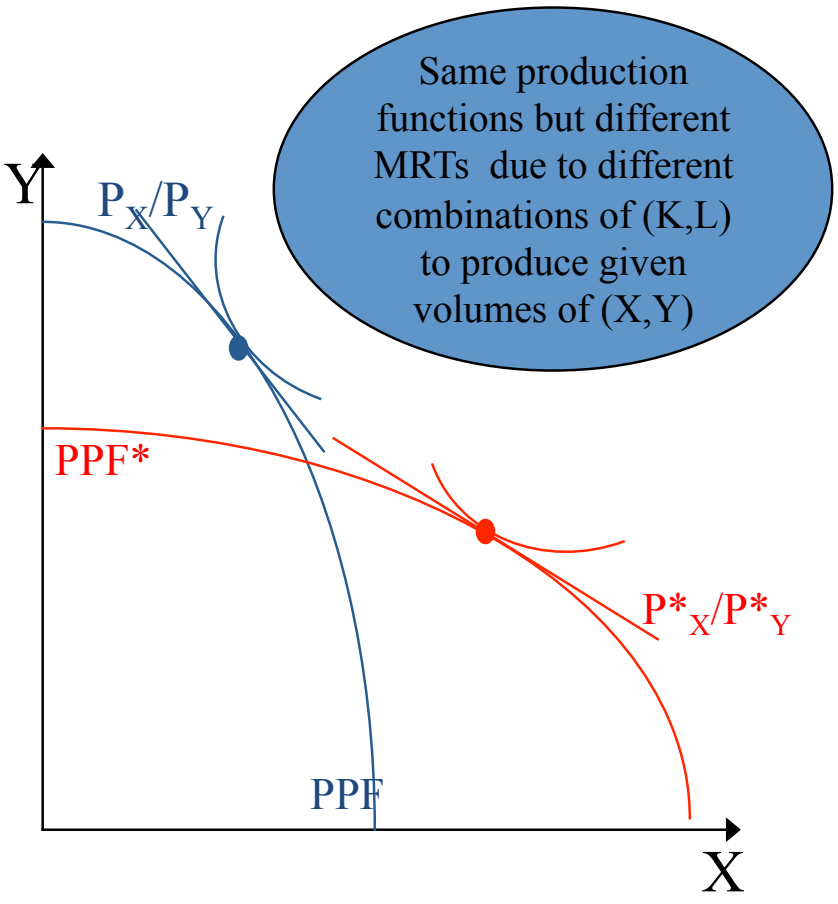


Demand side

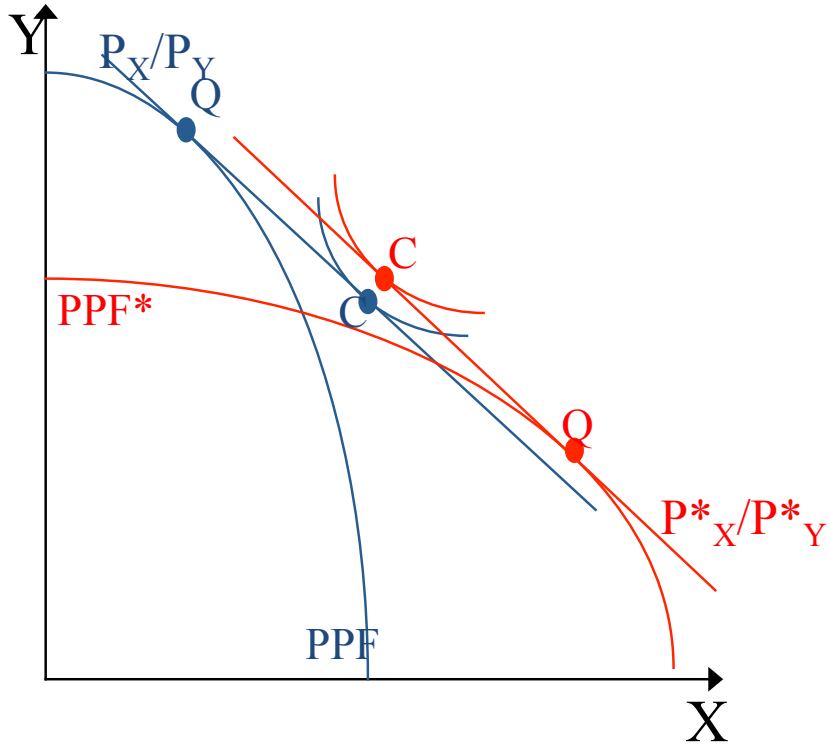


- On an indifference curve, $MRS = -\frac{dY}{dX} = \frac{\partial U/\partial X}{\partial U/\partial Y}$
- At the consumer's optimum : $\frac{P_X}{P_Y} = MRS$

Autarky



Open economy



Opening to Trade

- **Autarky** : $P_X/P_Y > P_X^*/P_Y^*$
- **Open economy** : Home starts importing X and Foreign starts importing Y

$\Rightarrow$ Increased demand of Y in Home and of X in Foreign $\longrightarrow$ Price convergence : $P_X/P_Y \downarrow$, $P_X^*/P_Y^* \uparrow$

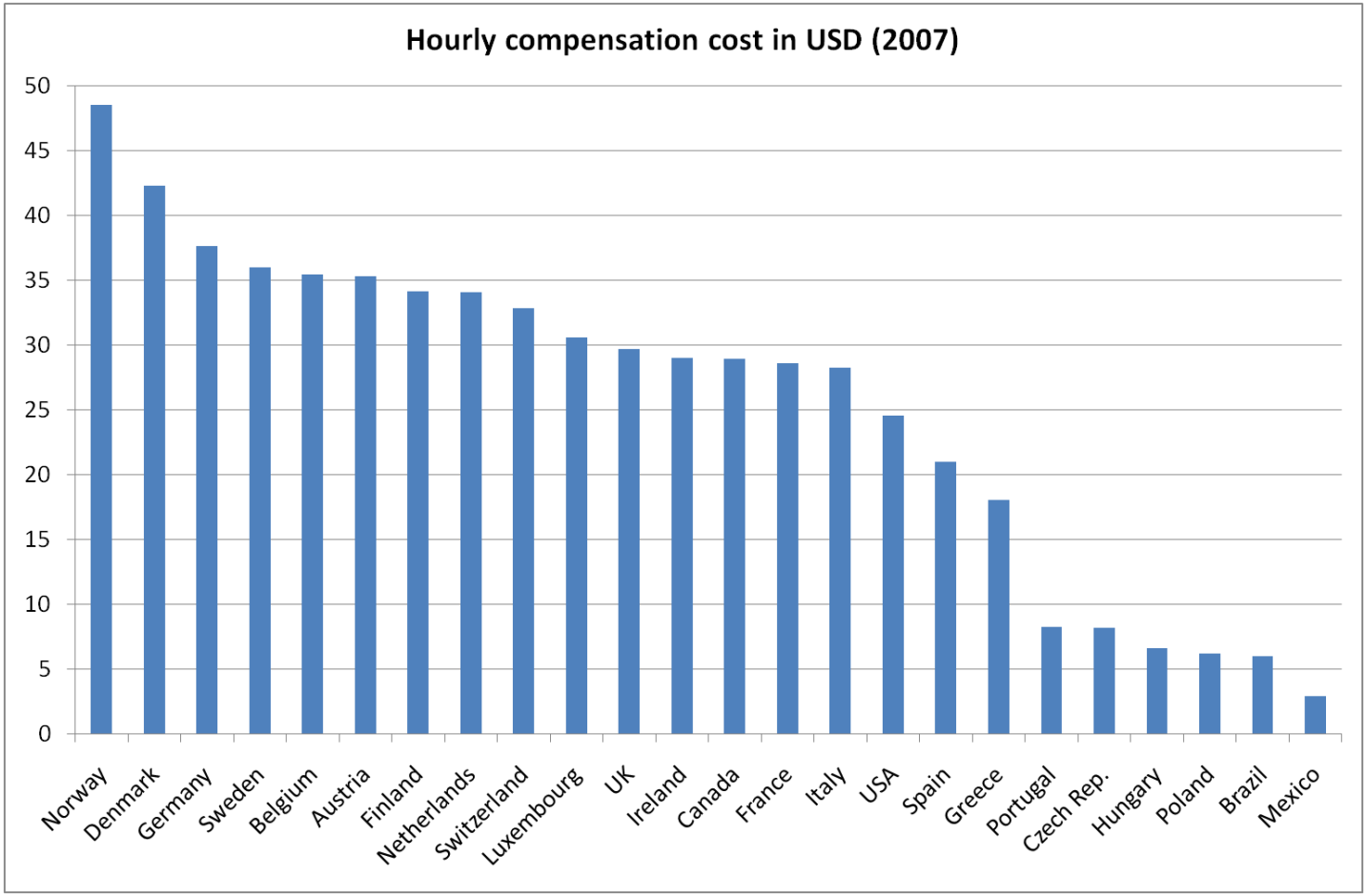
$\Rightarrow$ Relative production of Y increases in Home/decreases in Foreign $\longrightarrow$ Increased relative demand for capital in Home/for labor in Foreign $\longrightarrow$ $w/r \downarrow$, $w^*/r^* \uparrow$

Equalization of factor prices

- Opening up the economy leads to **relative factor price equalization** across countries, even though factors are immobile internationally
  - In each sector, price = marginal cost + Across countries, prices equalize in each sector $\longrightarrow$ Across countries, marginal costs equalize as well
  - Since production functions are the same in the two countries, the marginal cost is the same for each factor
- **Example** :
  - $P_X = w^{\alpha} r^{1-\alpha} = w^{*\alpha} r^{*1-\alpha}$ and $P_Y = w^{\beta} r^{1-\beta} = w^{*\beta} r^{*1-\beta}$
  - Then : $(w/r)^{\alpha-\beta} = (w^*/r^*)^{\alpha-\beta}$

$\Rightarrow$ **Heckscher-Ohlin-Samuelson theorem : "*International trade leads to relative factor price equalization through international price equalization.*"**

Empirical evidence : No wage equalization



Source : US Bureau of Labor Statistics (August 2009)

Limits

- No transport cost

→ Impact of tariff and non-tariff barriers ?

- Perfect competition (hence price = marginal cost)
- Homogeneous production functions across countries
- Perfect mobility of factors across industries
- Homogeneous production factors

Openness and income inequalities : the Stolper-Samuelson theorem

International trade and income inequalities

Stolper-Samuelson theorem :
"A rise in the relative price of a good increases the relative remuneration of the factor which is intensively used in the production of this good and reduces the remuneration of the other factor."

Hence opening up the economy leads to :

- A rise in the real remuneration of the relatively abundant factor
- A fall in the real remuneration of the relatively scarce factor

There are winners and losers :

- In Home, winners are the owners of physical and human capital
- In Foreign, winners are workers

Losers can theoretically be compensated through (preferably lump-sum) fiscal transfers from winners :

- In reality, physical and human capital is mobile internationally, which makes it difficult to tax them (tax competition)

Demonstration

- Zero profit :
  $P_X X = wL_X + rK_X \quad \Rightarrow \quad P_X = wa_{LX} + ra_{KX}$
  $P_Y Y = wL_Y + rK_Y \quad \Rightarrow \quad P_Y = wa_{LY} + ra_{KY}$
  with $a_{LX} = L_X/X$, $a_{KX} = K_X/X$, etc.
- Differentiate P_X et P_Y for a given production structure (given a_{ij}) :
  $dP_X = a_{LX}\,dw + a_{KX}\,dr$
  $dP_Y = a_{LY}\,dw + a_{KY}\,dr$
- Denote $\theta_{KX} = a_{KX}\,r/P_X$ and $\theta_{LX} = a_{LX}\,w/P_X$ (same for Y)

$$\frac{dP_X}{P_X} = \theta_{LX}\frac{dw}{w} + \theta_{KX}\frac{dr}{r} \qquad \frac{dP_Y}{P_Y} = \theta_{LY}\frac{dw}{w} + \theta_{KY}\frac{dr}{r}$$

Demonstration (2)

The evolution of factor prices then is :

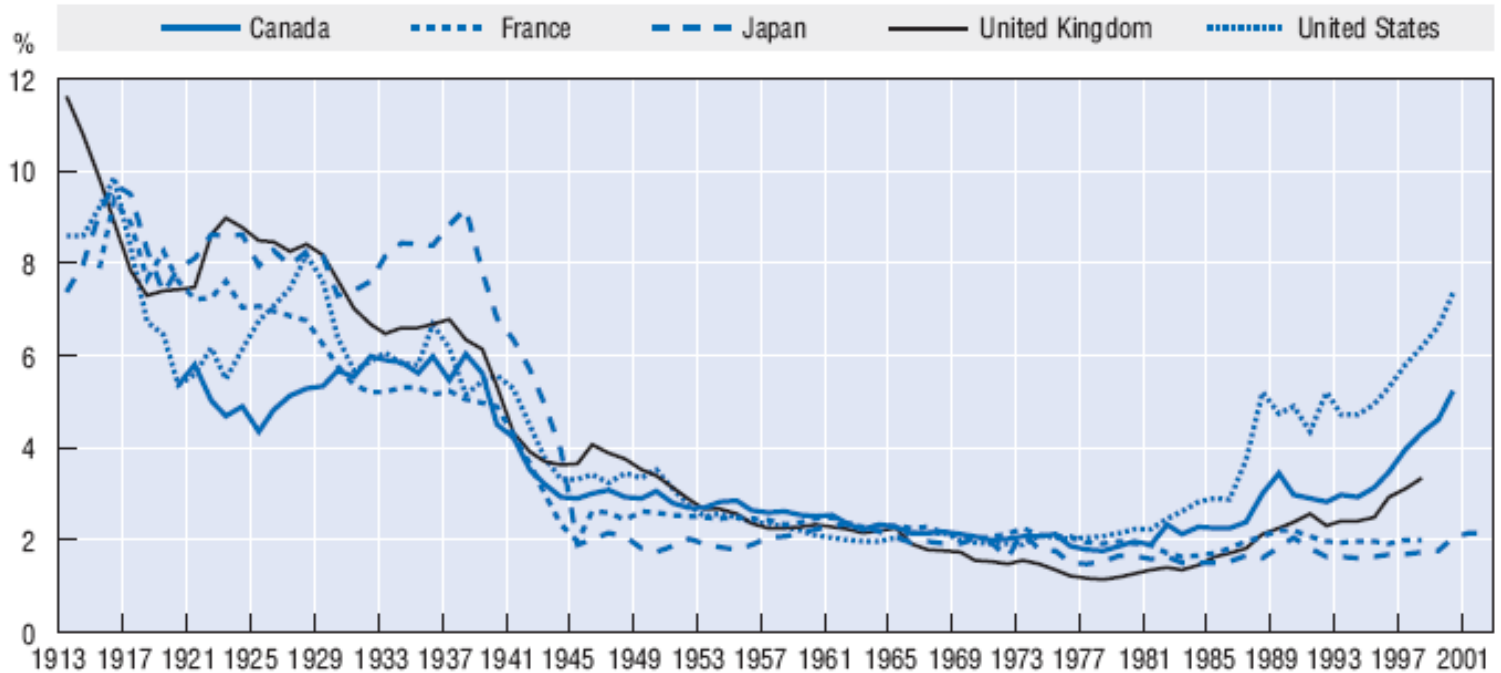
$$\frac{dw}{w} = \frac{\theta_{KY}\frac{dP_X}{P_X} - \theta_{KX}\frac{dP_Y}{P_Y}}{\theta_{KY}\theta_{LX} - \theta_{KX}\theta_{LY}} \quad \frac{dr}{r} = \frac{\theta_{LX}\frac{dP_Y}{P_Y} - \theta_{LY}\frac{dP_X}{P_X}}{\theta_{KY}\theta_{LX} - \theta_{KX}\theta_{LY}}$$

Since $\theta_{KY} > \theta_{KX}$ (Y is more capital intensive) and $\theta_{LX} > \theta_{LY}$ (X is more labor intensive), the denominator of both expressions is positive. It can be concluded that :

- if P_X (price of the relatively labor-intensive good) rises, then w (the remuneration of labor) increases while r (the remuneration of capital) falls
- if P_Y (price of the relatively capital-intensive good) increases, then w (the remuneration of labor) falls while r (the remuneration of capital) rises

Trade openness and inequality

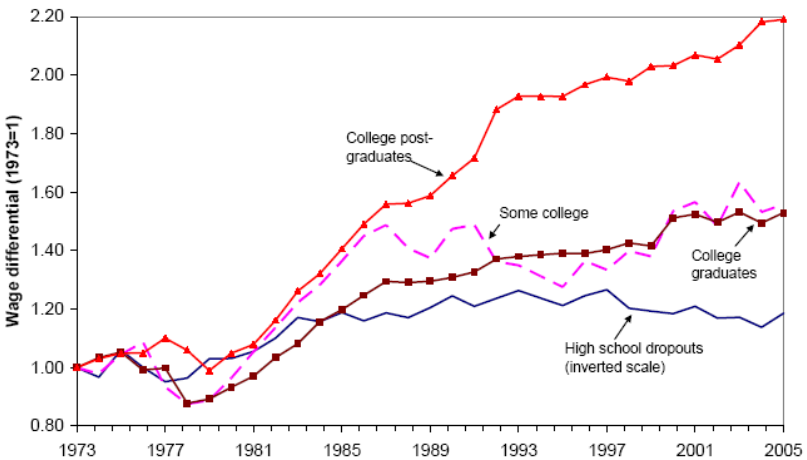
Top 0.1% income share in 5 OECD countries, 1913-2001



Source: Piketty and Saez (2006).

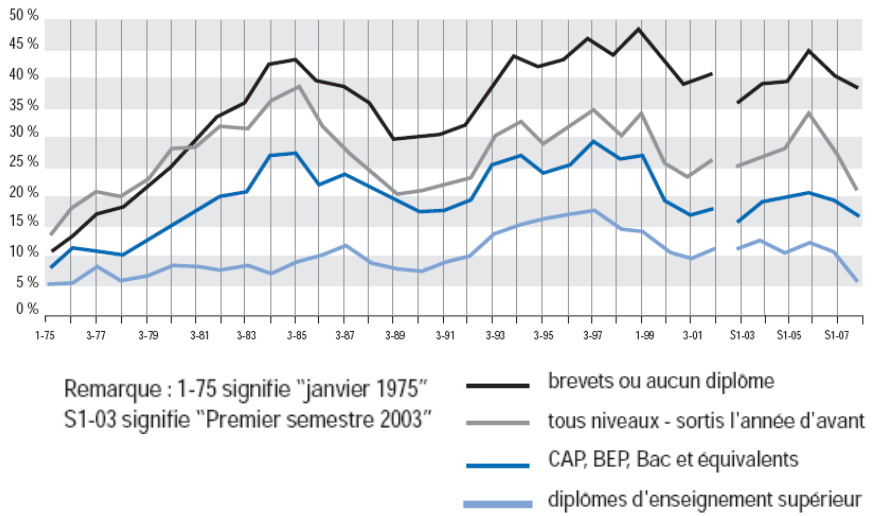
Wage versus unemployment inequalities

US : Hourly wage differentials relative to high school graduates (men)



Source : Lemieux (2008)

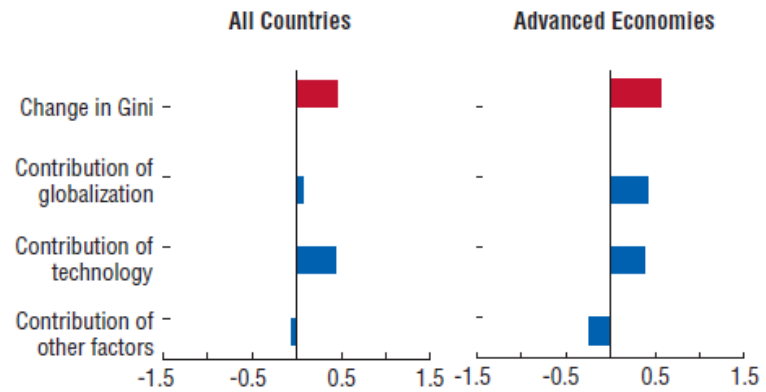
France : Unemployment rate 1-4 years after exiting the education system



Source : INSEE

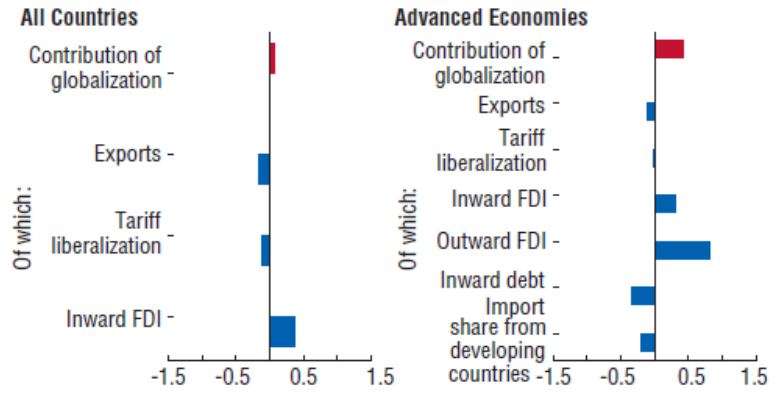
Explaining changes in income inequalities

Regression of Gini coefficient on globalization and technology-related variables



Average annual % change of Gini coefficient

Decomposition of globalization effects on inequality

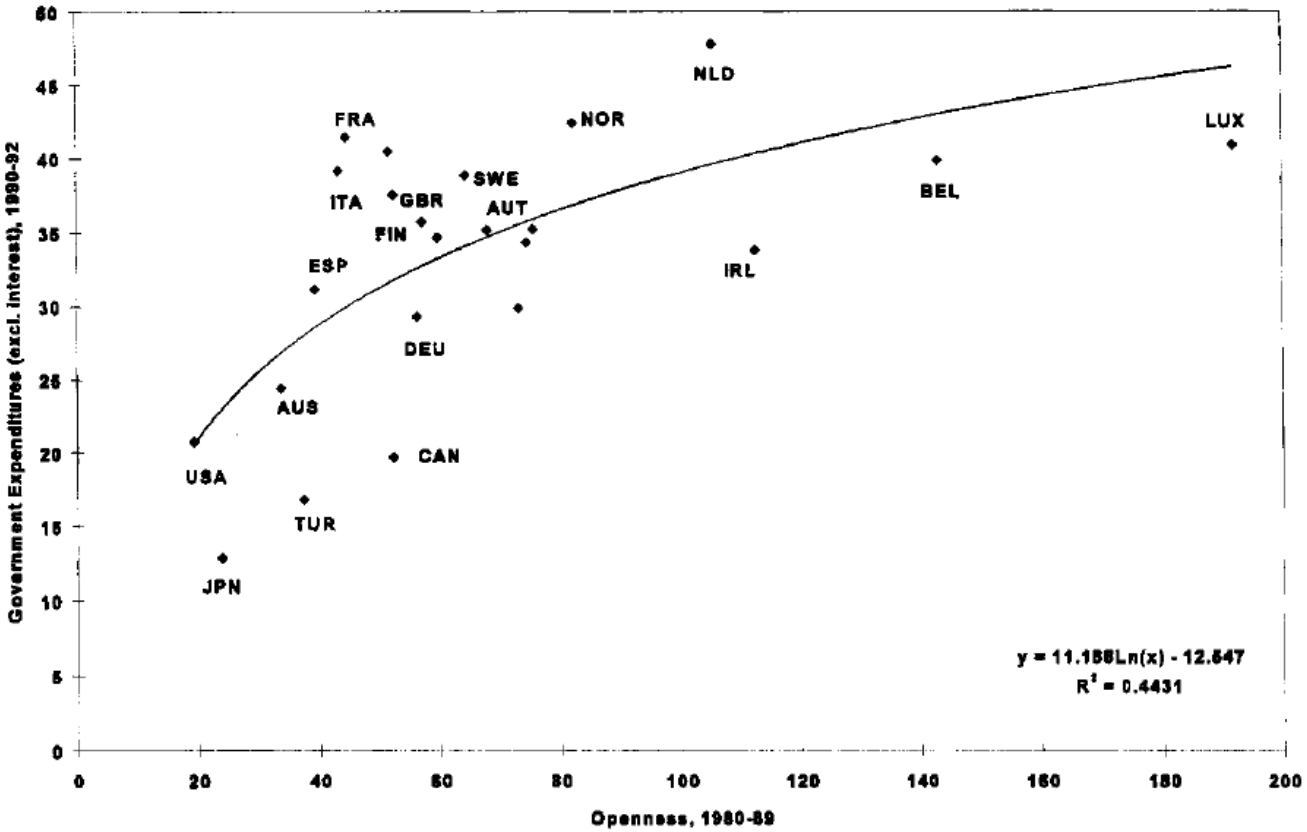


Average annual % change of Gini coefficient

Source : IMF, World Economic Outlook

Compensating the Losers

Trade openness and public expenditures



Source : D. Rodrik (1998)

The role of factor endowments : the Rybczynski theorem

Changes in factor endowments

Rybczynski theorem : "***For a given relative price, a higher endowment in one factor makes the production that uses this factor more intensively increase and the production that uses it less intensively decrease***"

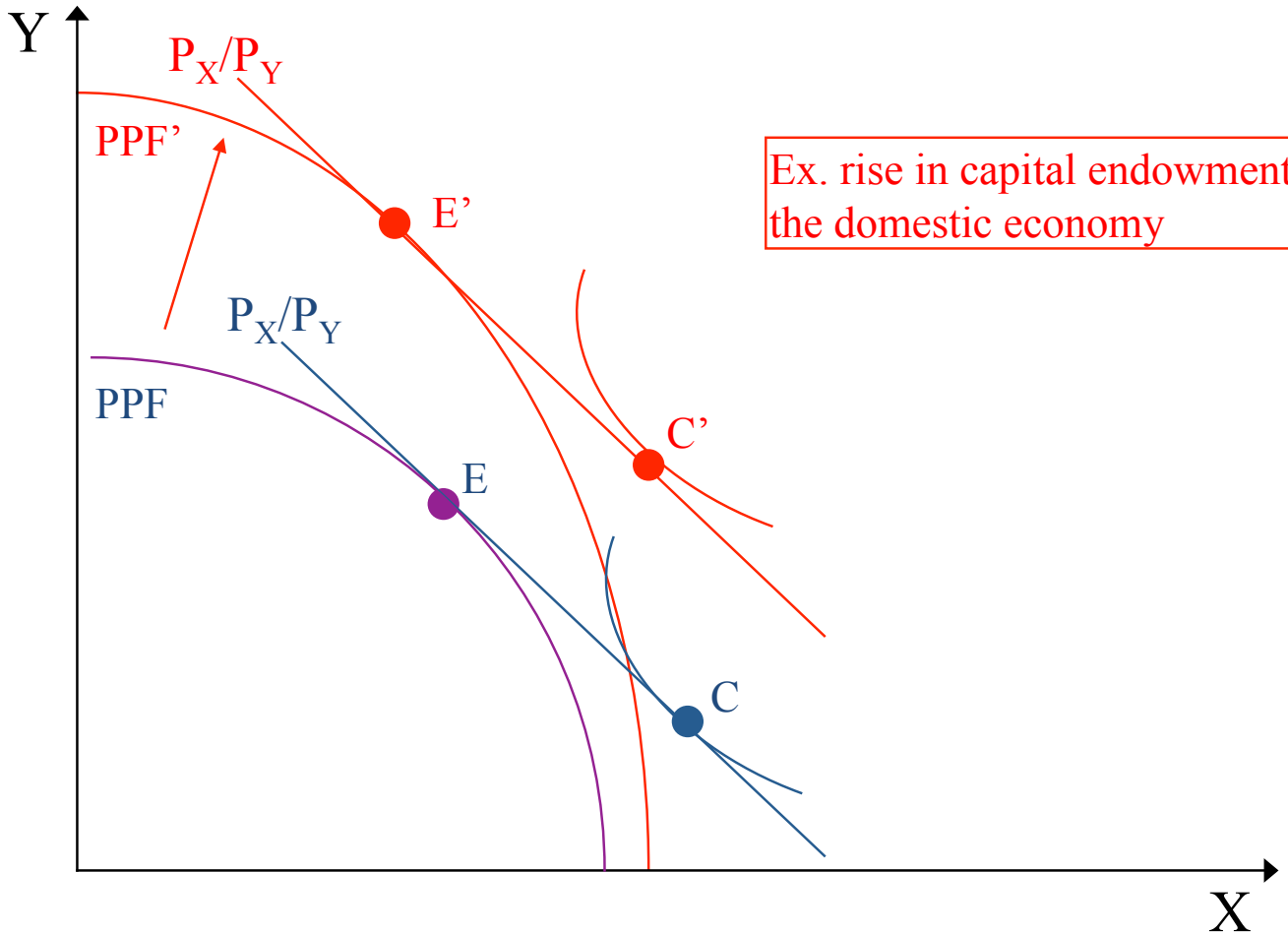
Consequences for a small economy (exogenous prices) :

A rise in factor endowment is necessarily beneficial because the country can either :

- Export more, hence import more and consume more (export-biased growth) ;
- Import less, export less, but consume more (import-substitution growth)

Comparative advantages can change over time. Ex. Japan, China, Vietnam.

The Rybczynski theorem



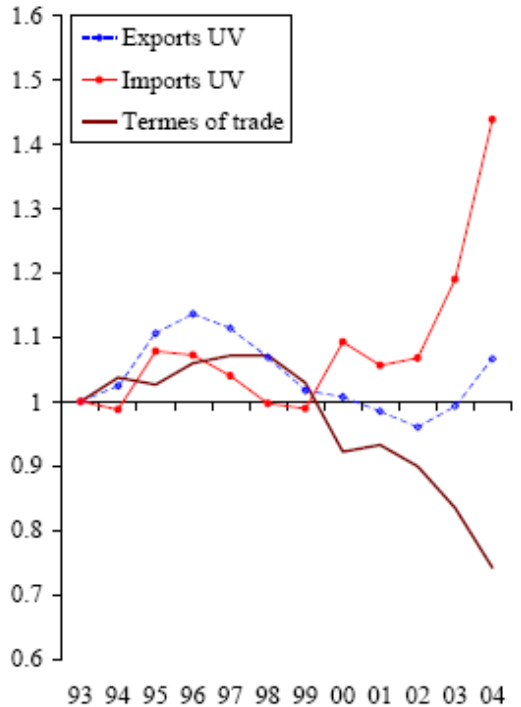
Ex. rise in capital endowment in the domestic economy

Limits

In a **big country**, prices are endogenous :

- Export-biased growth deteriorates terms of trade, which may offset the positive impact of higher endowment = "impoverishing growth". Ex. China.
- Justification to import-substitution policies

Terms of Trade in China



Source : Lemoine, 2007

The Leontieff paradox

The Leontieff paradox

Leontieff (1953) :

- US exports are labor intensive
  $K/L = 13{,}992$
  \$/person-year
- US imports (or, rather, US substitutes to imports) are more capital intensive
  $K/L = 18{,}184$
  \$/person-year

Contradicts the theory of comparative advantage

Possible explanations :

- Some imports have no substitute(ex. raw materials)
- Protection of labor-intensive industries
- Calculation should be based on bilateral trade
- Heterogeneity of factors (labor skills) or missing factors (land)
- Different technologies
- Limited inter-industry mobility
- Imperfect competition on goods and factor markets
- Vertical division of labor (exchange of tasks rather than goods).

Other attempts to validate HOS

- **Heckscher-Ohlin-Vanek (1968)**
  - Factoral content of exports should match world distribution of factors
  - ex. Export of labor-intensive goods if $L/L_{world} > Y/Y_{world}$

$\Rightarrow$ **Bowen, Leamer et Sveikaukas (1987)**

  - 12 factors of production, 27 countries
  - Fail to find "correct" ranking of countries

- **Trefler (1993, 1995)**
  - 9 factors, 33 countries, year 1983
  - 28% correlation between net factor exports and factor endowments
  - problem : net exports are close to zero

Conclusion

At this stage, we have explained :

- why countries with different technologies and/or different production factor endowments trade with each other (ex : US and China)
- why different goods are being exchanged ("inter-industry trade")
- why openness to trade may increase wage inequality

At this stage, we have not explained :

- why similar countries trade with each other (ex : France and Germany)
- why similar goods are being exchanged ("intra-industry trade")
- how/why labor and capital move across countries