INTERNATIONAL TRADE - ECON 245

FABIAN ECKERT

TWO SECTOR MODELS

BASIC RICARDO

NEOCLASSICAL TRADE: TWO PRINCIPAL APPROACHES

- Ricardian Model: Countries trade because they have different technologies
  - The U.S. exports skilled services because it has frontier ICT infrastructure
- Heckscher-Ohlin Model: Countries trade because they have different factor endowments
  - The U.S. exports skilled services because it has many skilled workers
- Both translate into differences in relative autarky prices and hence trade.
  - We start with a simple Ricardian model

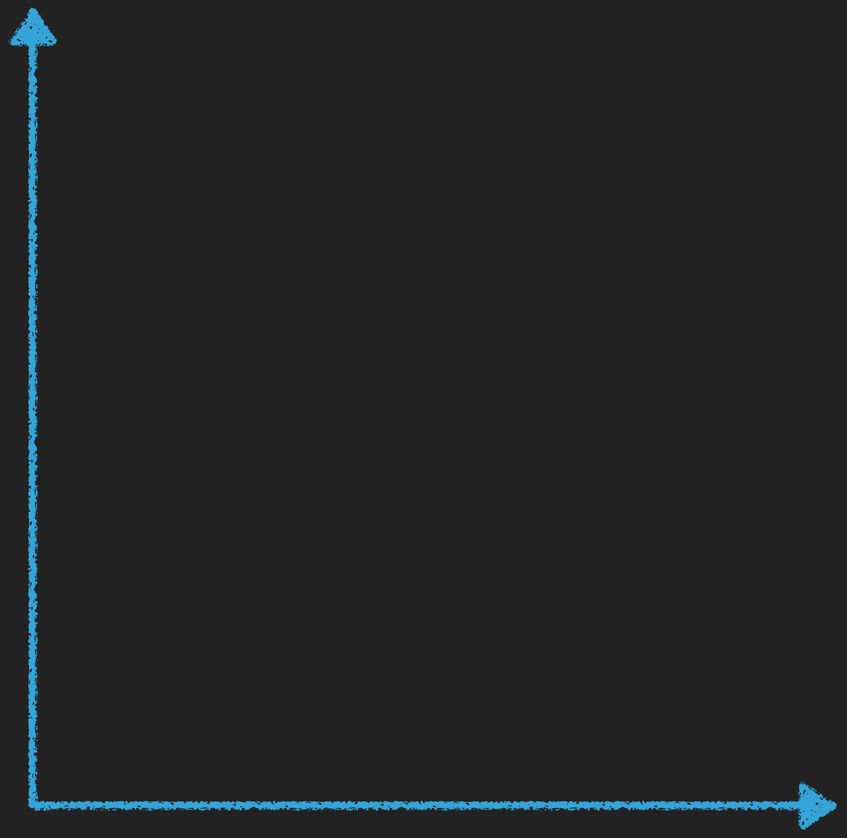
NOTATION

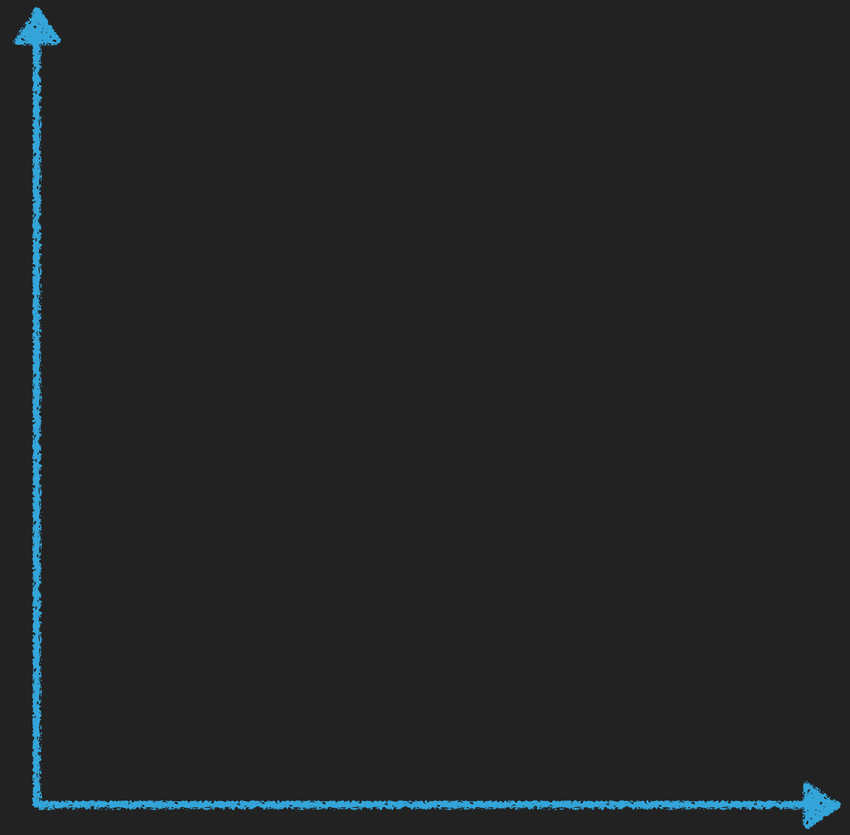
- Locations, Countries, Regions: c
- Sectors, Industries, Goods: i
- Skill, Education, Worker Types: k
- Home x, Foreign $x^\star$ occasionally

THE BASIC RICARDIAN MODEL

- a_i and $a_i^\star$ units of labor per unit of production of good i in home and foreign
- Labor mobile across sectors, immobile across countries
  - Both goods only produced if wages the same across sectors

$$\frac{p_1}{a_1} = \frac{p_2}{a_2} \Rightarrow \frac{p_1}{p_2} \equiv p = \frac{a_1}{a_2}$$



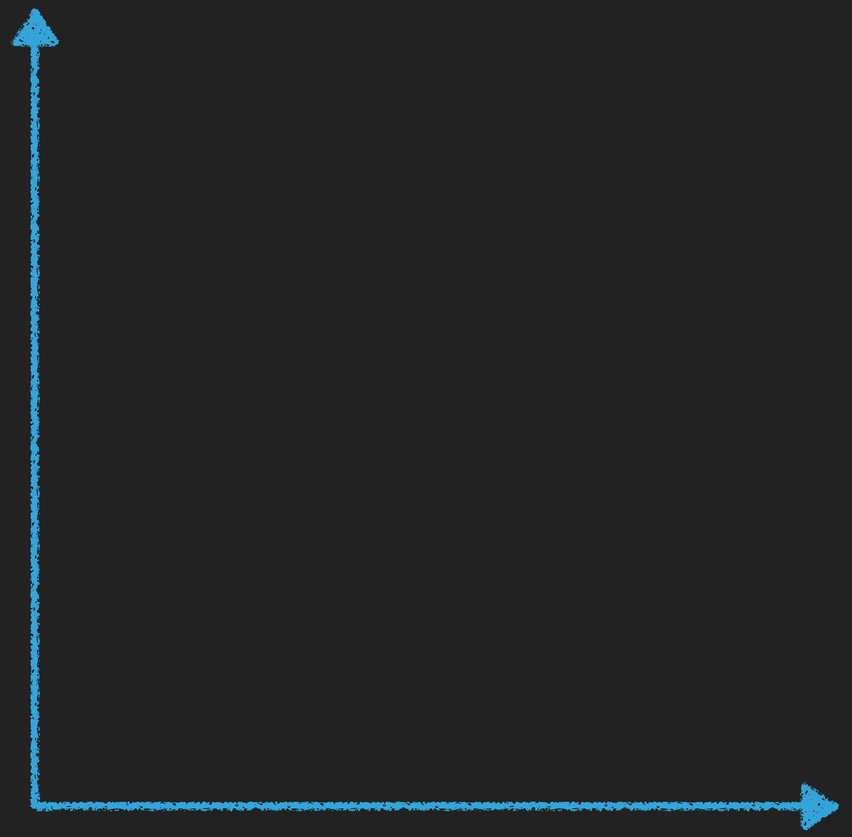


THE BASIC RICARDIAN MODEL

- Suppose home has a comparative advantage in sector 1: $a_1/a_2 < a_1^\star/a_2^\star$
- There are three cases:
  - $p < p^a$ and $p < p^{a\star}$: both specialize in good 2
  - $p^a < p < p^{a\star}$: home specializes in good 1, foreign in good 2
  - $p^a < p$ and $p^{a\star} < p$: both specialize in good 1
- World relative supply is a step function!

THE BASIC RICARDIAN MODEL

- What about world relative demand?
  - Assume identical homothetic preferences across countries
  - Relative demand, d_1/d_2, slopes downward as a function of relative price
- Trade patterns are determined by *comparative advantage*, even if one country has an *absolute advantage* in *both* sectors
  - Wages adjust to make trade worthwhile for both countries
  - Trade patterns determined by CA – wages determined by AA



THE BASIC RICARDIAN MODEL AND US CITIES

- Can use this framework to think about regions in the United States.
- Average Wages in big US cities have grown faster than wages elsewhere
  - To first order big cities' population are stable
- For wages to grow faster, Ricardo would say productivity must have risen faster
  - What could explain this?
- This has testable implications for trade flows; and for flows of people.

BASIC HECKSCHER-OHLIN

THE BASIC HECKSCHER OHLIN MODEL

- Two goods and two factors of production
- Production function in each sector:

$$y_i = f_i(L_i, K_i)$$

where f is increasing, concave, and homogeneous of degree 1 in (L_i, K_i)

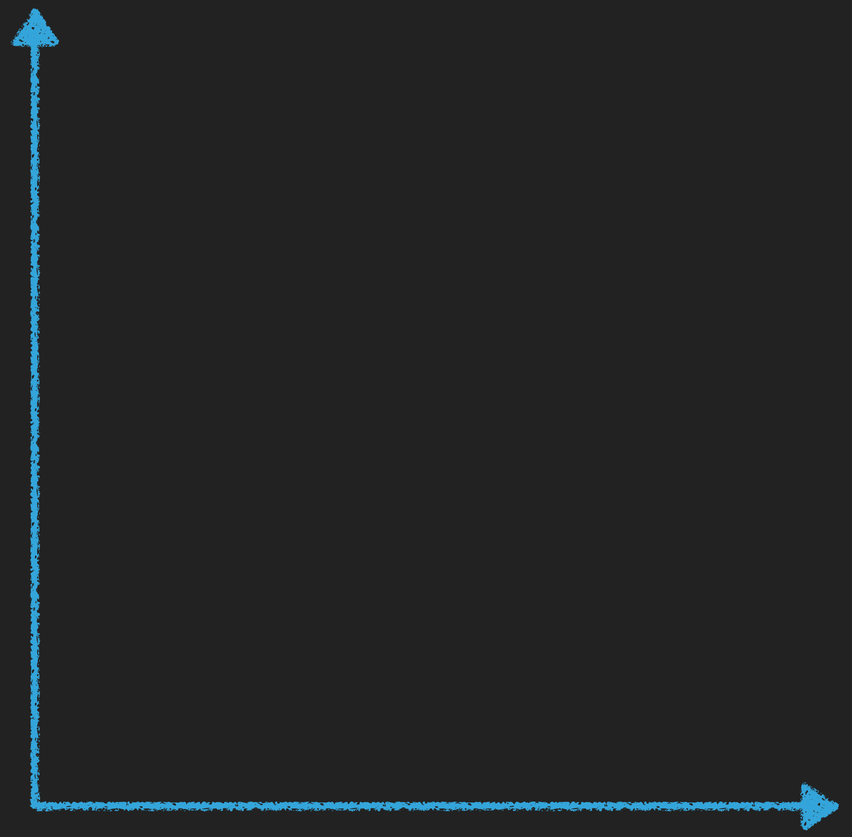
- Hence there are Constant Returns to Scale (CRS)
- Factors are fully mobile, and in fixed supply
  - The resource constraints are $L_1 + L_2 = L$ and $K_1 + K_2 = K$

THE BASIC HECKSCHER OHLIN MODEL

- Maximizing output of good 2 subject to constraints and y_1 we obtain the production possibility frontier (PPF):

$$y_2 = h(y_1, L, K)$$

- The PPF is concave since f_i was assumed concave.
  - Delineates a convex production possibilities set
  - Summarizes the technology of the economy
- Assume perfect competition (“market structure“) and exogenous prices



THE BASIC HECKSCHER OHLIN MODEL: EQUILIBRIUM

- Unit cost function:

$$c_i(w, r) = \min_{L_i, K_i \geq 0} \left(wL_i + rK_i \mid f_i(L_i, K_i) \geq 1 \right)$$

- Unit costs are marginal and average cost due to CRS
- Write the solution to minimization problem as follows:

$$c_i(w, r) = wa_{iL}(w, r) + ra_{iK}(w, r) = wa_{iL} + ra_{iK}$$

- Using envelope theorem: $\partial c_i / \partial w = a_{iL}(w, r)$ etc

THE BASIC HECKSCHER-OHLIN MODEL: EQUILIBRIUM CONDITIONS

- Zero Profit Condition:

$$p_i = c_i(w, r)$$

- Factor Market Clearing:

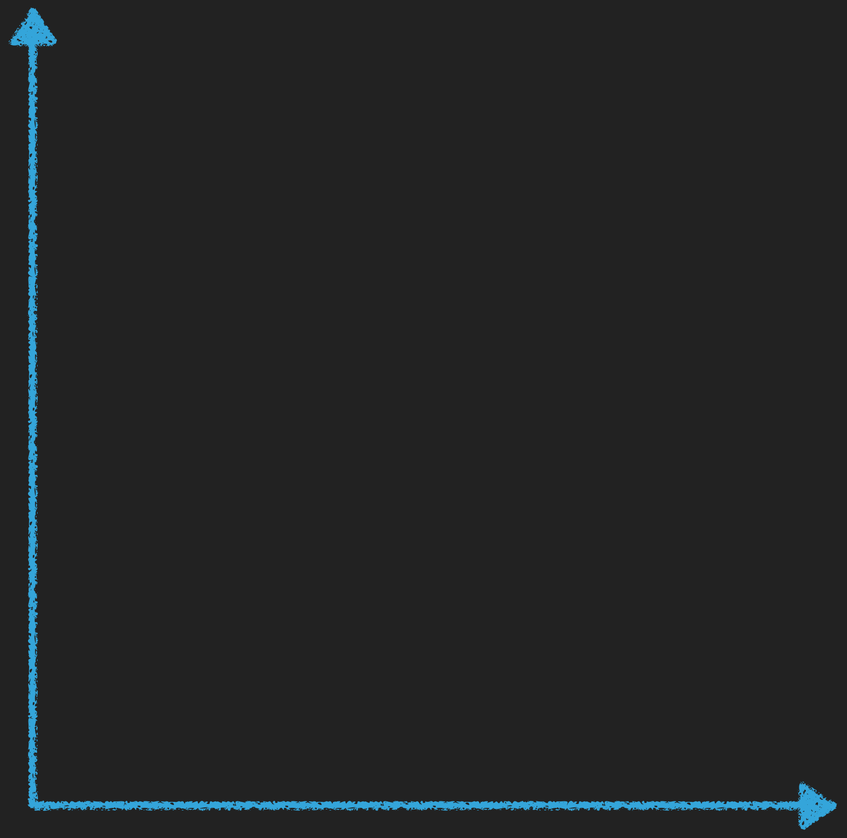
$$a_{1L}y_1 + a_{2L}y_2 = L \quad a_{1K}y_1 + a_{2K}y_2 = K$$

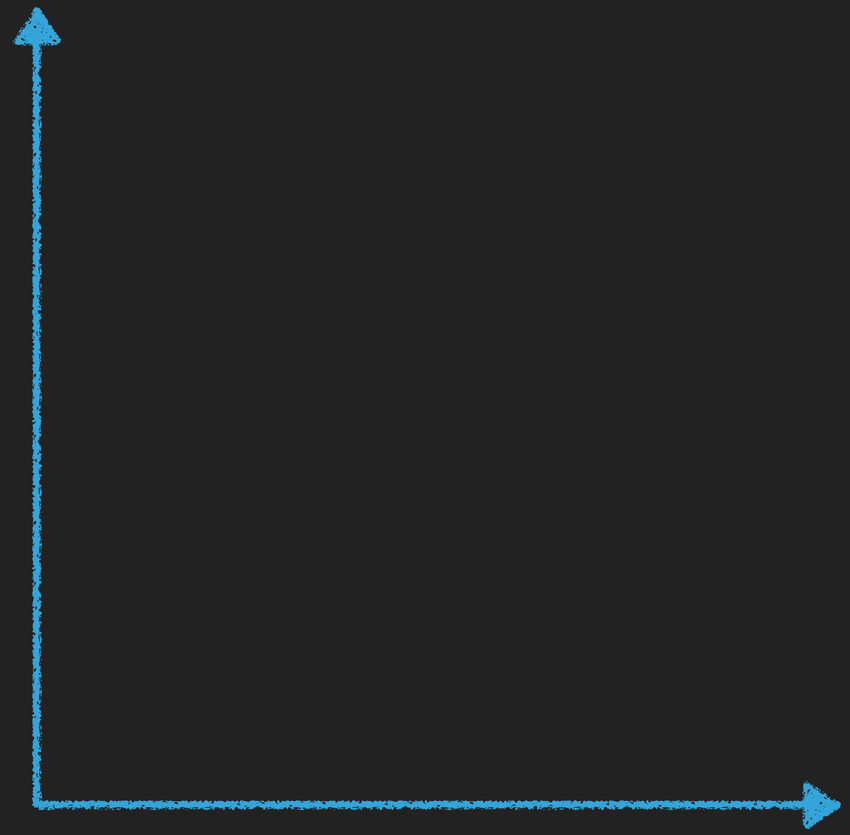
- Four equations in four unknowns (w, r, y_1, y_2)
  - (p_1, p_2, L, K) are parameters we will do comparative statics on
  - Unit cost functions are non-linear: what are properties of this system?

THE BASIC HECKSCHER OHLIN MODEL: DETERMINING FACTOR PRICES

Lemma (Factor Price Insensitivity): So long as both goods are produced, and factor intensity reversals (FIRs) do not occur, each price vector (p_1, p_2) corresponds to unique factor prices (w, r).

- Factor Endowments *irrelevant* for factor price determination!
  - In sharp contrast with one sector models!
    - Endowments can grow without affecting prices!





THE BASIC HECKSCHER OHLIN MODEL: DETERMINING FACTOR PRICES

Theorem (Factor Price Equalization): Suppose that two countries are engaged in free trade, having identical technologies but different factor endowments. If both countries produce both goods and FIRs do not occur, then the factor prices (w, r) are equalized across the countries.

- Trade in goods equalizes factor prices, i.e., as if we had free factor mobility!
  - In sharp contrast to one sector model!
- Why can labor abundant country pay same wage as labor scarce country?

THE BASIC HECKSCHER OHLIN MODEL: CHANGE IN PRODUCT PRICES

- If output prices change, how will factor prices change?
- Differentiate the zero profit conditions:

$$dp_i = a_{iL}dw + a_{iK}dr \Rightarrow \frac{dp_i}{p_i} = \frac{wa_{iL}}{c_i}\frac{dw}{w} + \frac{ra_{iK}}{c_i}\frac{dr}{r} \Rightarrow \hat{p}_i = \theta_{iL}\hat{w} + \theta_{iK}\hat{r}$$

- "Jones Algebra" – Jones JPE 1965

Theorem (Stolper-Samuelson): An increase in the relative price of a good will increase the real return to the factor used intensively in that good, and reduce the real return to the other factor.

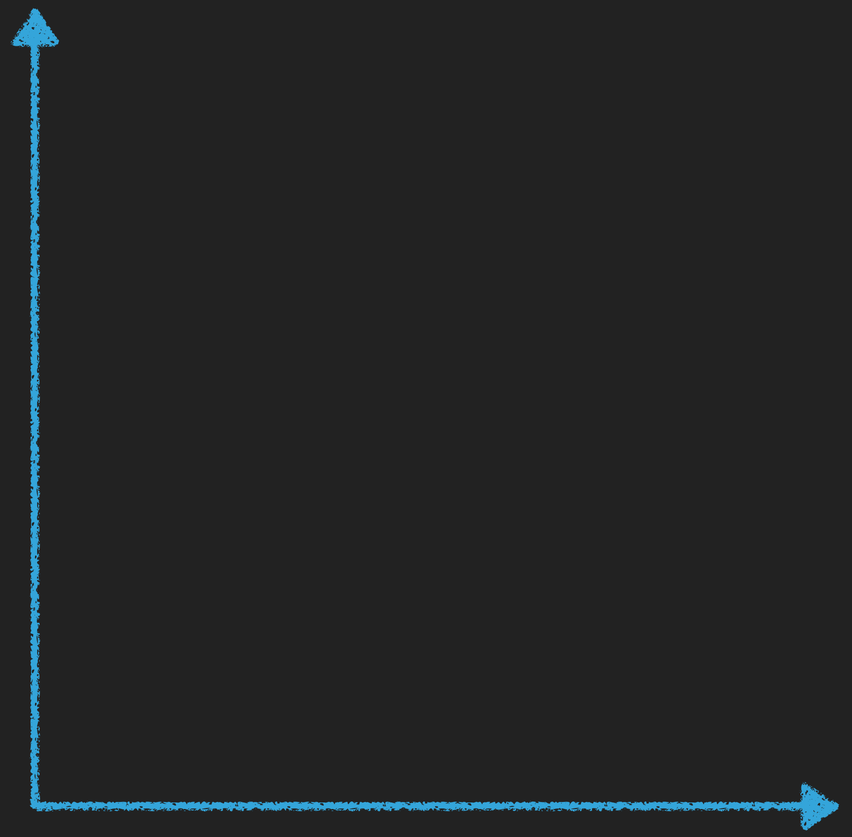
PROOF OF STOLPER-SAMUELSON (1941) THEOREM

THE BASIC HECKSCHER OHLIN MODEL: CHANGE IN PRODUCT PRICES

- Jones (1965) Magnification Effect:

$$\hat{w} > \hat{p}_1 > \hat{p}_2 > \hat{r}$$

- Change in product prices has *magnified* effect on factor prices.
  - Trade has real distributional consequences, making one factor *worse* off!



THE BASIC HECKSCHER OHLIN MODEL: CHANGE IN ENDOWMENTS

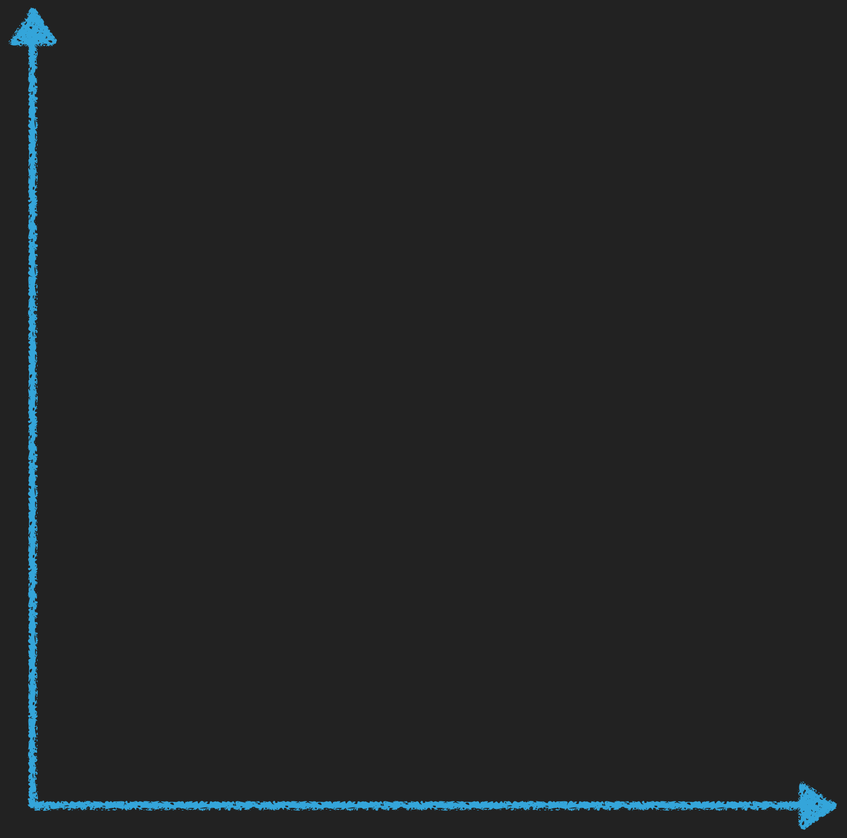
- Totally differentiate the factor market clearing equations to get:

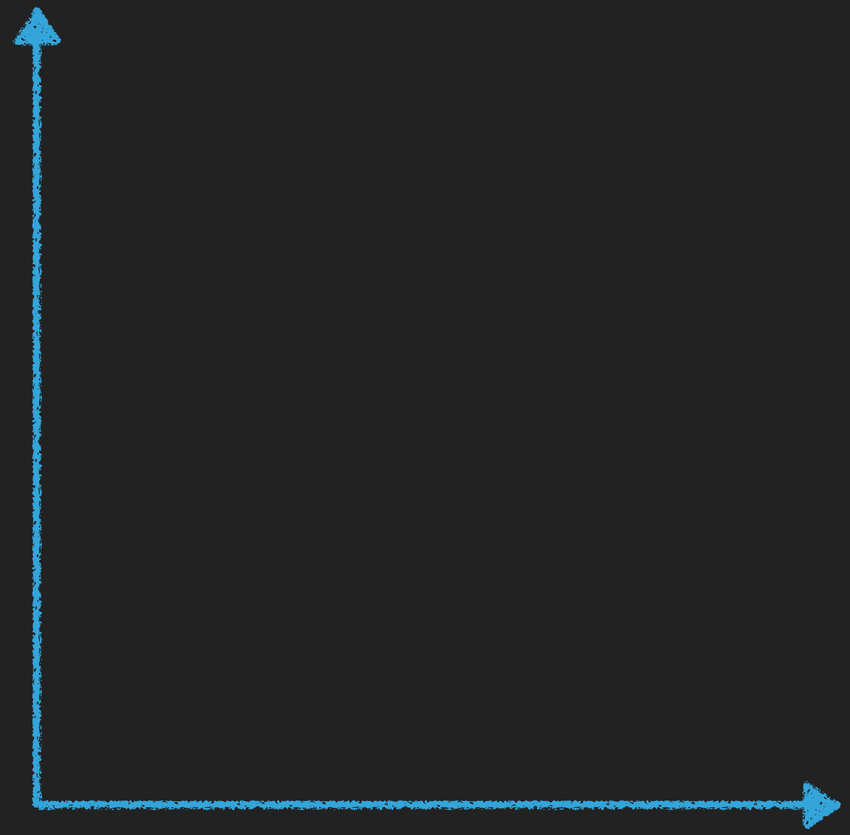
$$a_{1X}dy_1 + a_{2X}dy_2 = dX \Rightarrow \frac{a_{1X}y_1}{X}\frac{dy_1}{y_1} + \frac{a_{2X}y_2}{X}\frac{dy_2}{y_2} = \frac{dX}{X} \Rightarrow \lambda_{1X}\hat{y}_1 + \lambda_{2X}\hat{y}_2 = \hat{X}$$

- Similar result to Stolper-Samuelson but for output.

Theorem (Rybczynski): An increase in the factor endowment will increase the output of the industry using it intensively, and decrease the output of the other industry.

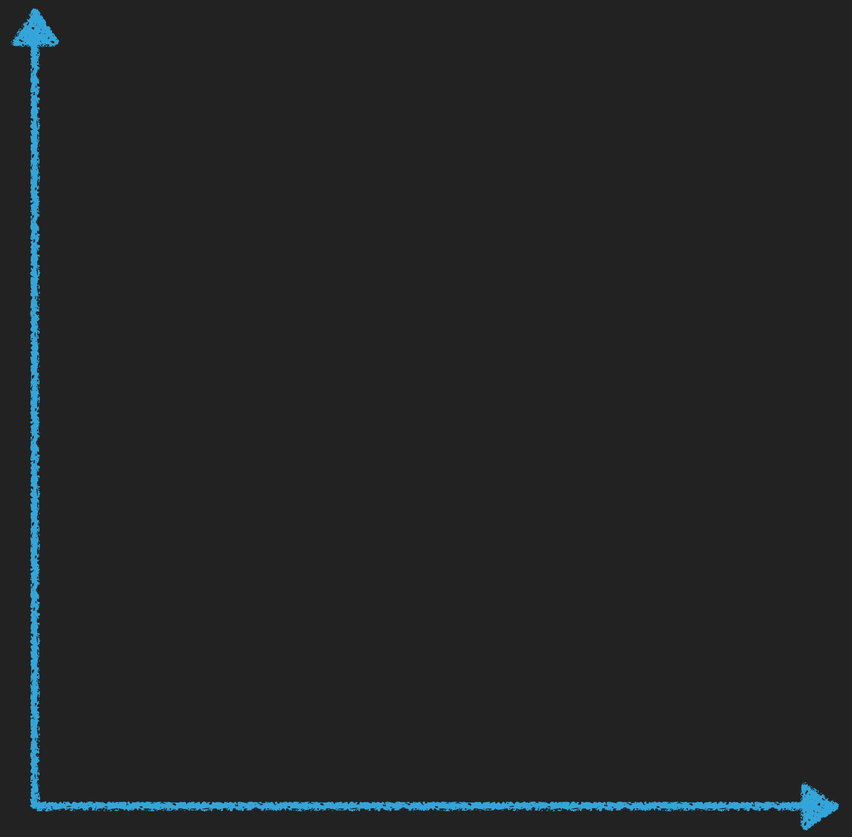
- Example of the Rybczynski effect is is the *Dutch Disease* phenomenon





THE BASIC HECKSCHER OHLIN MODEL: FACTOR PRICE EQUALIZATION REVISITED

- Samuelson's thought experiment:
  - Pool world endowments and assume they are free to move
  - For which endowment combinations do we get diversification?
  - Within this cone factor prices are constant
    - So within it any distributions of factors across countries would yield FPE and diversification
    - The area within the parallelogram is referred to as the FPE set.



THE BASIC HECKSCHER OHLIN MODEL: CHANGE IN ENDOWMENTS

- How can we be sure that outputs will be positive?
- As long as new endowments are within the *Cone of Diversification* outputs are positive
  - Else: produce only one good, so factor prices determined by marginal product of labor+depend on endowments.
  - Factor price insensitivity lemma no longer applies!

THE BASIC HECKSCHER OHLIN MODEL: FACTOR INTENSITY REVERSALS

- What if just one good is produced or there are FIRs?
- In this case the zero profit conditions yield two solutions for factor prices
  - Two possible cones of diversifications!
  - The endowments then determine in which cone (if any!) an economy is.
    - Factor prices depend on the endowments of the economy, but are independent of them within each cone
  - We can have diversification but no FPE across countries!