ECO364H1S: International Trade Theory

Lecture 5

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- Last Class
  - Three theorems in the HO model

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- Today
  - Factor Price Equalization
  - Factor Content of Trade

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  - Factor Price Equalization
  - Factor Content of Trade
- Readings
  - None!

HO Model and Factor Price Equalization

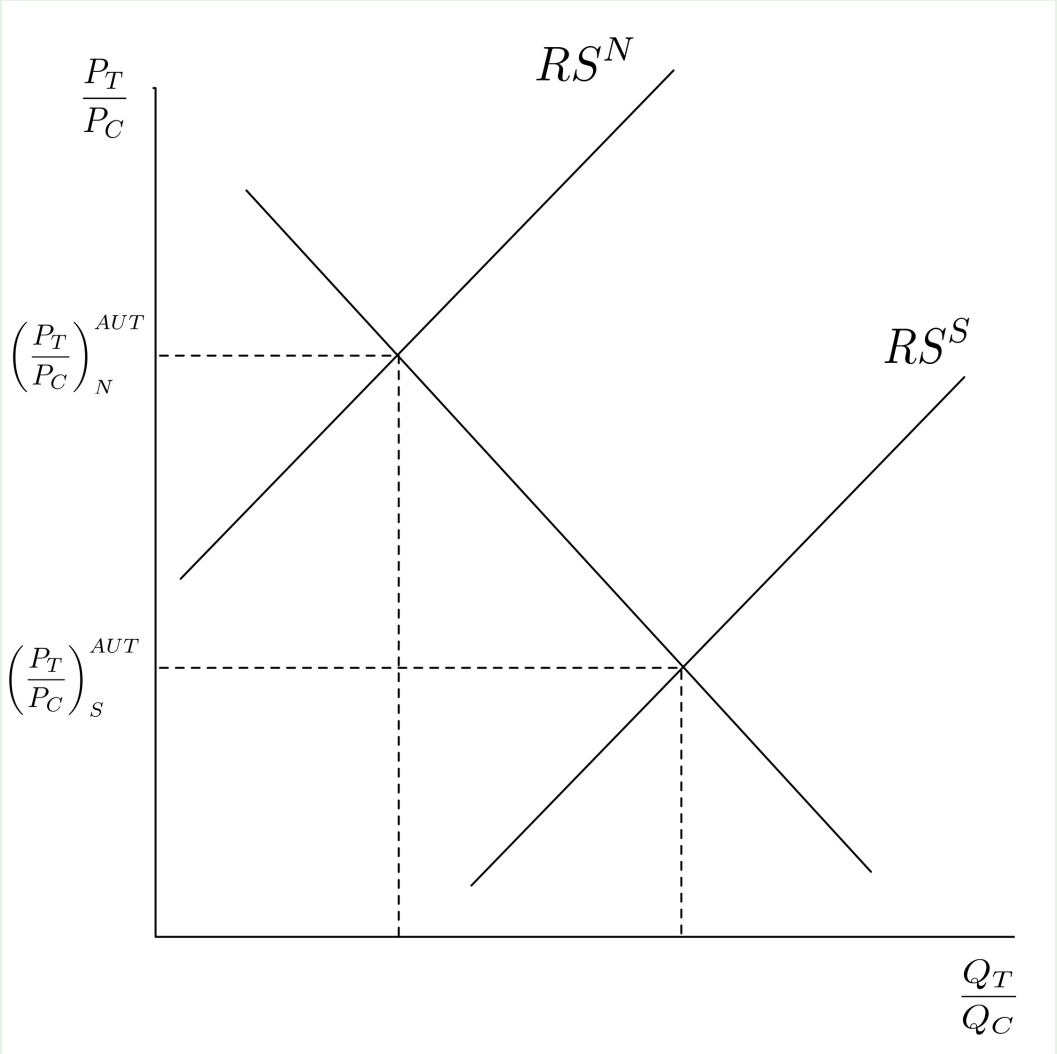
- Based on a country's factor endowments we were able to make the following predictions
  - Capital abundant countries export capital intensive goods and import labour intensive goods
  - The return to capital owners in the capital abundant country increases while the return to labour owners decreases
  - Conversely, the return capital owners in the labour abundant country decreases while the return to labour owners increases

HO Model and Factor Price Equalization

- When countries are allowed to trade, there appears to be a convergence in factor prices
  - **Factor Price Equalization (FPE)**
- Let's look at this more closely

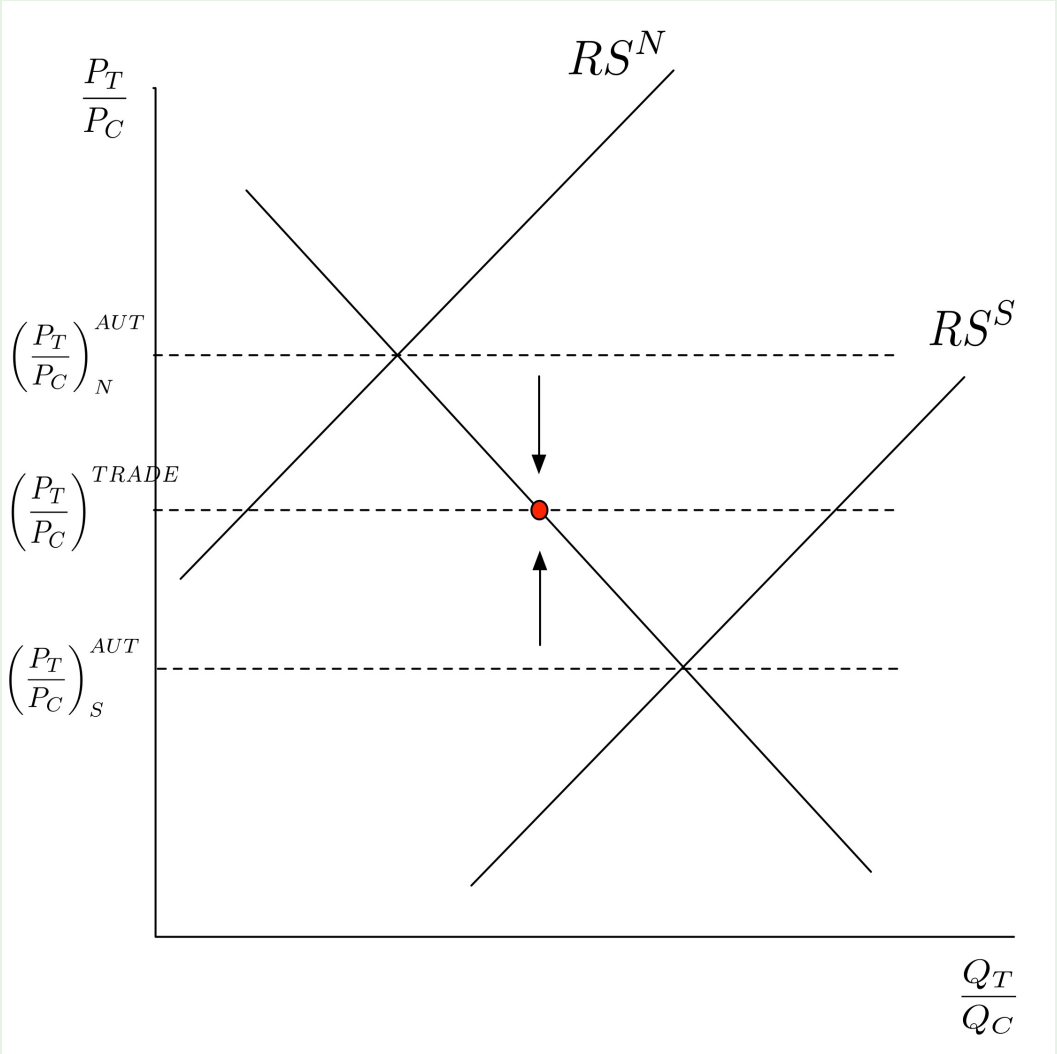
RS-RD in Autarky

Recall that we can visualize the autarky relative price in each country using RS-RD graph



FPE

Under free trade, each country's relative good prices converges as price differences are arbitraged away



FPE

- Convergence in their relative goods prices results in a convergence in their relative factor prices
  - Why? the two countries share the same SS curve (i.e. same production function for a given good)
- Example
  - Assume production takes skilled and low-skilled labour as inputs
  - Result suggests that if skilled workers make 2x the pay of low-skilled workers in Canada, under free trade, skilled workers will also make 2x the wage of low-skilled workers in Mexico

FPE

- Why is this happening?
  - We assumed that factors cannot move across countries
- Trade of goods can be interpreted as embodying trade in the factors used to produce those goods
- More concretely, when textiles manufactured in China are imported into Canada, the textiles embody the labour and capital used to produce the textiles

FPE

- In terms of the results we derived in the HO model, a capital abundant country exports capital-intensive goods and imports labour intensive goods
  - This can be interpreted as exporting capital and importing labour
- Let's look at some of the empirical evidence for this

Factor Content Studies

- ***How much trade in factors is implied by trade in goods?***
- Start with the volume of exports and imports
- Using unit labour requirements, calculate how much labour does net imports embody
- For now, focus on just two factors: skilled and unskilled labour
    - Other measurable factors may include physical and investment capital, land, etc.

Assumptions and Definitions

- Assumptions:
  - Two factors: skilled and unskilled labour
  - Two goods: computers and textiles
  - North exports computers and the South exports textiles
- Define the following notations:
  - Final goods:
    - X_C^N: Northern exports of computers to the South
    - X_T^S: Southern exports of textiles to the North
  - Input factors:
    - S_i^j: Skilled labour employment in sector i in country j
    - U_i^j: Unskilled labour employment in sector i in country j

Unit Labour Requirements

- $a^N_{S,C}$: unit skilled labour requirement for computers in the North
- $a^N_{U,C}$: unit unskilled labour requirement for computers in the North
- Production functions:

$$Q^N_C = \frac{1}{a^N_{S,C}} S^N_C \implies a^N_{S,C} = \frac{S^N_C}{Q^N_C}$$

$$Q^N_C = \frac{1}{a^N_{U,C}} U^N_C \implies a^N_{U,C} = \frac{U^N_C}{Q^N_C}$$

- Similar formulation for South

Unit Labour Requirements

- Notice that the right hand side of these unit labour requirements are variables that we can observe
  - We are just backing out the unit labour requirements from the data
- A few more definitions and we're read to make some calculations

Skilled and Unskilled Labour in Exports

- Define S^j_{Trade} and U^j_{Trade} as the skilled and unskilled labour that is embodied in the exports of country j

$$S^N_{Trade} = a^N_{S,C} X^N_C + a^N_{S,T} X^N_T \ , \ \ S^S_{Trade} = a^S_{S,C} X^S_C + a^S_{S,T} X^S_T$$

$$U^N_{Trade} = a^N_{U,C} X^N_C + a^N_{U,T} X^N_T \ , \ \ U^S_{Trade} = a^S_{U,C} X^S_C + a^S_{U,T} X^S_T$$

  - e.g. $a^N_{S,C} X^N_C$ is the amount of skilled labour exported by North from the computer industry

Change in Endowment Stock due to Trade

- When the two countries are trading, the amount of skilled and unskilled labour in their country that will change because of trade is defined as

$$\tilde{S}^N = S^N - S^N_{Trade} + S^S_{Trade} \quad \tilde{S}^S = S^S - S^S_{Trade} + S^N_{Trade}$$

$$\tilde{U}^N = U^N - U^N_{Trade} + U^S_{Trade} \qquad \tilde{U}^S = U^S - U^S_{Trade} + U^N_{Trade}$$

- S^i and U^i is the total stock of skilled and unskilled labour in country i

Example

- Suppose endowments were $S^N = 200$, $U^N = 100$, $S^S = 100$, and $U^S = 200$
- Under free trade, imagine that North exports 10 computers while South exports 10 units of textiles
  - All other trades are zero
- Assume that the unit labour requirements are

$$a^N_{S,C} = 1/5 \ , \quad a^S_{S,T} = 1/10$$

$$a^N_{U,C} = 1/10 \ , \quad a^S_{U,T} = 1/5$$

Example

- Plugging these values into our formula predicts North importing one unit of unskilled labour and exporting one unit of skilled labour
  - **In-class exercise**
  - In other words, the net change in skilled and unskilled labour due to trade are $\tilde{S}^N = 199$, $\tilde{U}^N = 101$, $\tilde{S}^S = 101$, $\tilde{U}^S = 199$
- Unfortunately, the prediction of the theory does not fit the data well
  - But it doesn't mean it is useless! Computing these values are relatively easy and can help establish baseline results

Factor Content Studies and Data

- U.S. is one of the most advanced country in the world based on the amount of capital being used per person in production compared to other countries
  - E.g. one worker operating many machines to make a car
- According to our theory, the U.S. should be a net exporter of capital-intensive goods and a net importer of labour-intensive goods
- In a study done in 1953, economist Wassily Leontief found that U.S. exports were less capital-intensive than U.S. imports
  - This inconsistency with the theory is named the Leontief Paradox

Leontief Paradox

Factor Content of U.S. Exports and Imports for 1962

	Imports	Exports
Capital (million $)	2.132	1.876
Labor (person-years)	119	131
Capital-labor ratio ($/person)	17,916	14,321
Average years of education per worker	9.9	10.1
Proportion of engineers and scientists in work force	0.0189	0.0255

Leontief Paradox

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- U.S. exported goods that embodied more labour than its imports
- Imported more capital than it exported
- Other data shows the prediction consistent with the theory
  - Exports are more technology-intensive than imports

Leontief Paradox

- Why did this happen?

Leontief Paradox

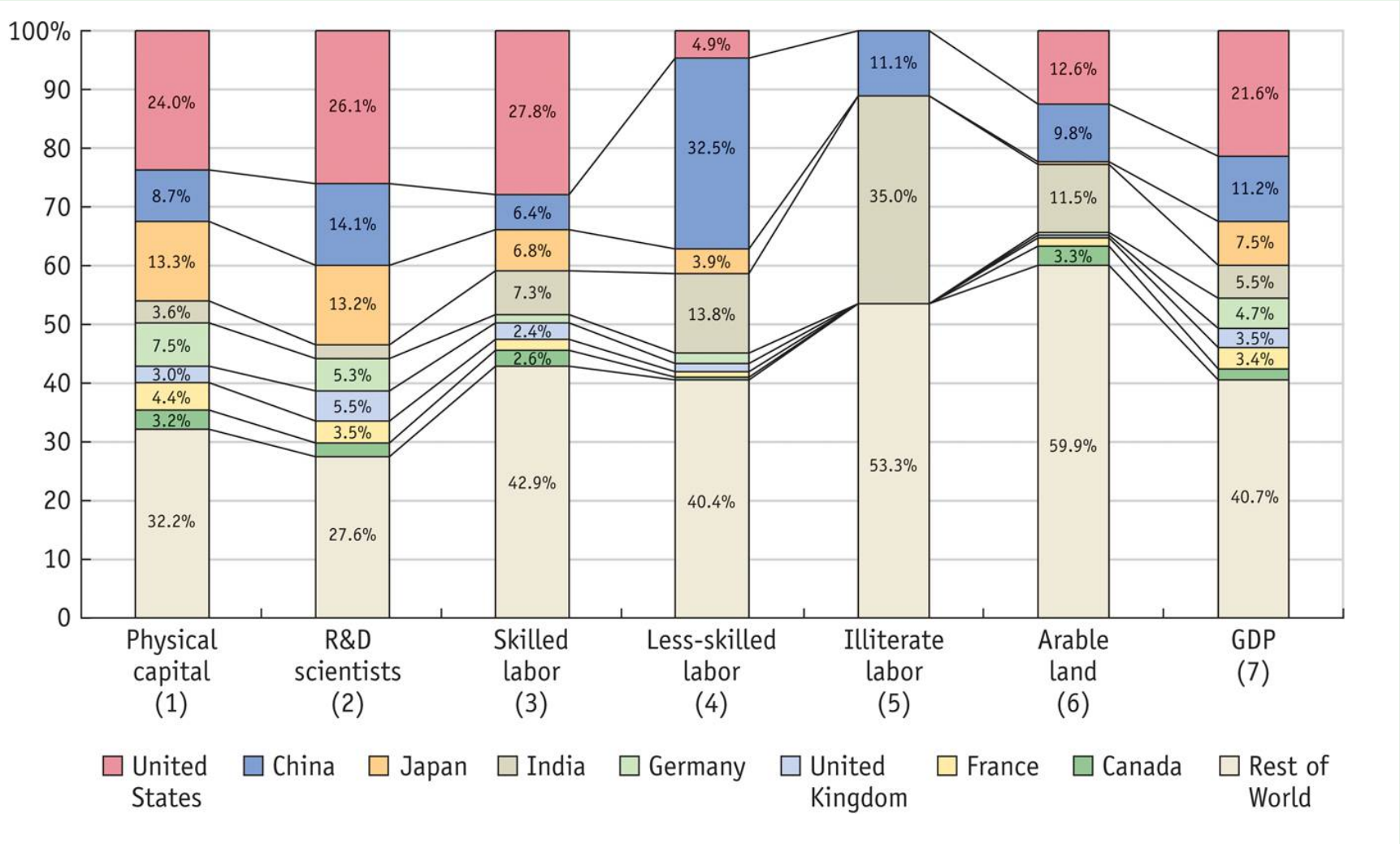
- Leontief only looked at labour and capital
  - Land is an important factor of production in the U.S.
- Leontief used U.S. technology to impute the factor content of U.S. imports
  - He assumed that all countries used the same technology, perhaps guided by assumption in the HO model
  - Developed countries have more skilled labour and innovative entrepreneurship (low physical capital) v.s. large scale manufacturing (high physical capital) in developing countries
- Leontief treated labour used in the U.S. exports and imports to be the same
  - No distinction made between skilled and unskilled labour

Test on Global Data

- Since the U.S. might be a special case, researchers have undertaken this study for other countries
- Instead of measuring relative factor endowment within a country, compute the country's share of a factor endowment in the whole world
- If the share of that factor is greater than the country's share of world GDP, that country must be abundant in that factor
    - In 2008, China had 7% of world income but roughly 20% of the world's workers $\implies$ China is labour abundant
    - According to the HO model, China should be a net exporter of labour (as embodied in final goods traded)
    - Conversely, they should be a net importer of investment capital

Test on Global Data

Each country's share of global supply of each factor



Test on Global Data

- The approach used by Bowen, Leamer, and Sveikauskas (1987) is to check whether a country was a net exporter of an input factor for 27 countries
- Success is recorded if a country is observed to be a net exporter of a factor that they are relatively abundant in
  - They checked this for 12 input factors
- Tally success / failure of the sign test across the 27 countries for each input factor

Test on Global Data

For 2/3 of the factors of production, trade ran in the direction predicted by the HO theory less than 70% of the time

Factor of Production	Predictive Success*
Capital	0.52
Labor	0.67
Professional workers	0.78
Managerial workers	0.22
Clerical workers	0.59
Sales workers	0.67
Service workers	0.67
Agricultural workers	0.63
Production workers	0.70
Arable land	0.70
Pasture land	0.52
Forest	0.70

* Fraction of countries for which net exports of factor runs in predicted direction.

Source: Harry P. Bowen, Edward E. Leamer, and Leo Sveikauskas, "Multicountry, Multifactor Tests of the Factor Abundance Theory," *American Economic Review* 77 (December 1987), pp. 791–809.

Test on Global Data

- Factor content of trade ran in the opposite direction of prediction in (on average) 39% of the cases
- According to the results, HO theory based on standard assumptions failed
- Confirms the Leontief Paradox at a more global level

The Case of the Missing Trade

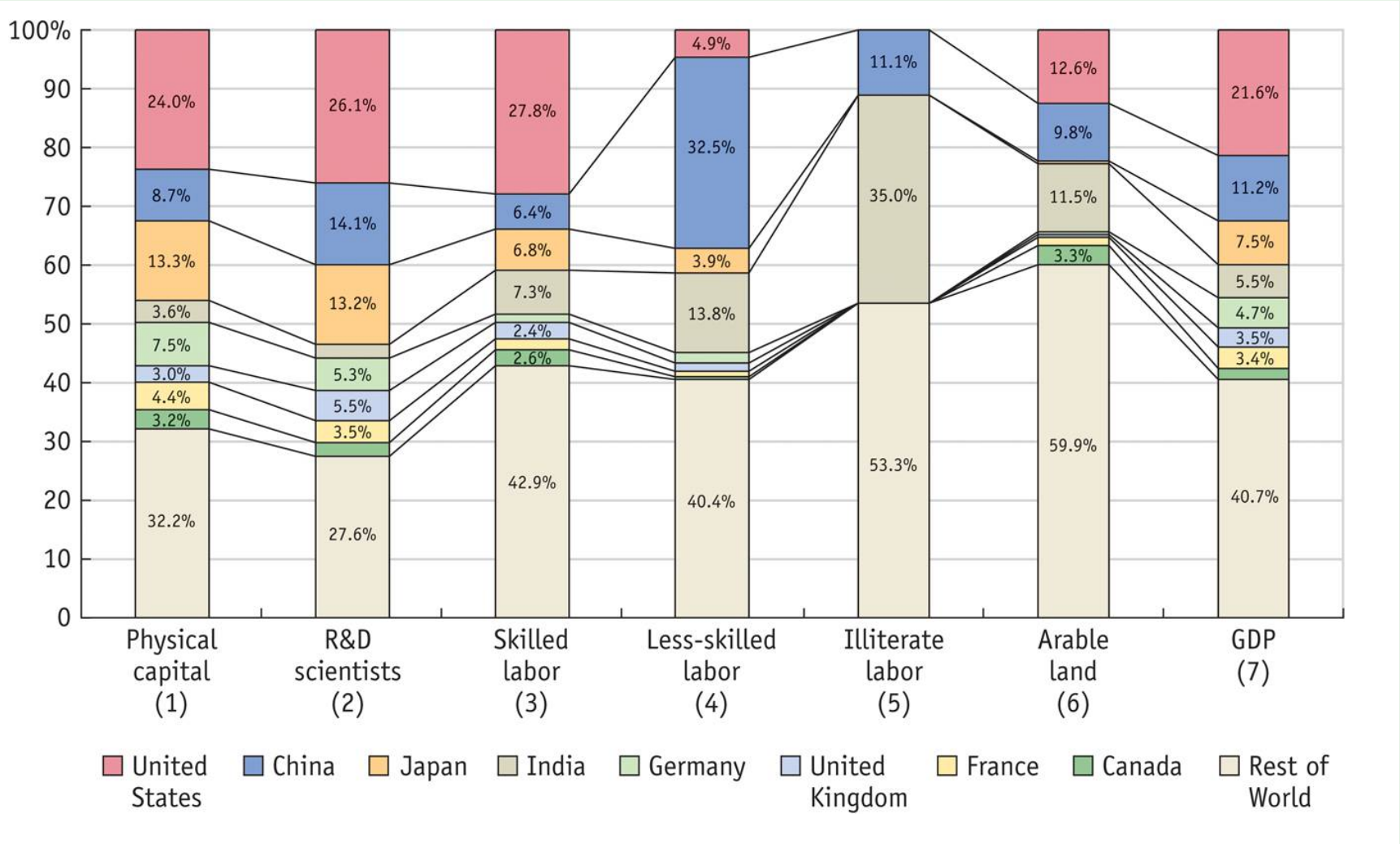
- Large differences in technology across countries might explain why the HO model is inconsistent with what is observed in the data
- Workers in more advanced countries may be more productive than workers in developing countries
- We must reconsider how we define a factor endowment

Effective Factor Endowment

- Effective Factor Endowment = Actual Factor Endowment x Factor Productivity
- "If workers in the United States are much more efficient than the world average, then the "effective" labor supply in the United States is correspondingly larger—and hence the expected volume of imported labor services into the United States is correspondingly lower"
  - KOM, 5.3

Effective Factor Endowment

- Figure before accounting for factor productivity



Effective Factor Endowment

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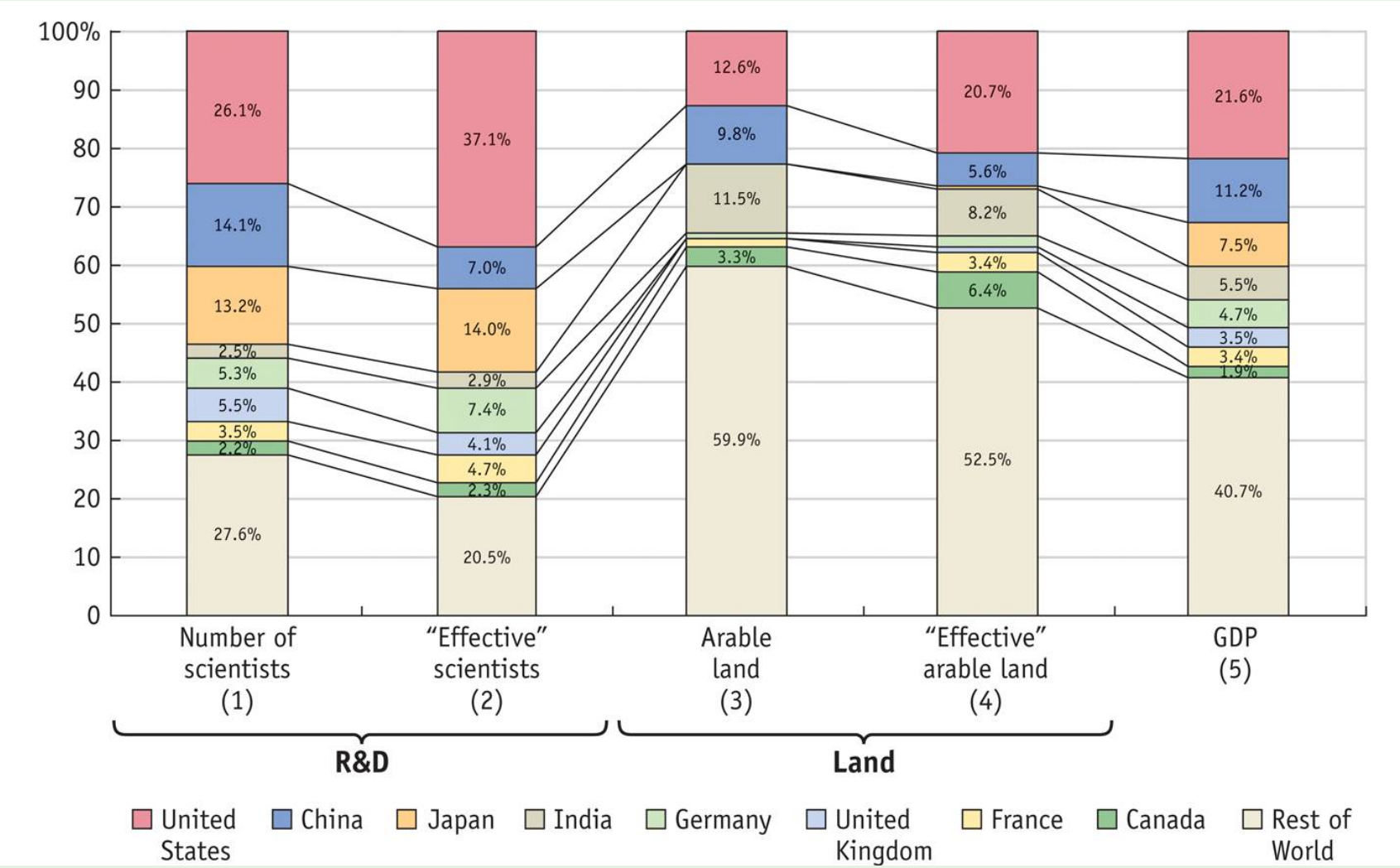


Effective Factor Endowment

- Other issues arise when technological differences are not accounted for
- Given that the U.S. only had 5% of the world's share of workers but make up 23% of the world's income, the HO model predicts that the U.S. will import goods that embody nearly 4 times it's own labour endowment
- But calculation of the factor content of U.S. trade showed only a small net import of labour
    - Same for China

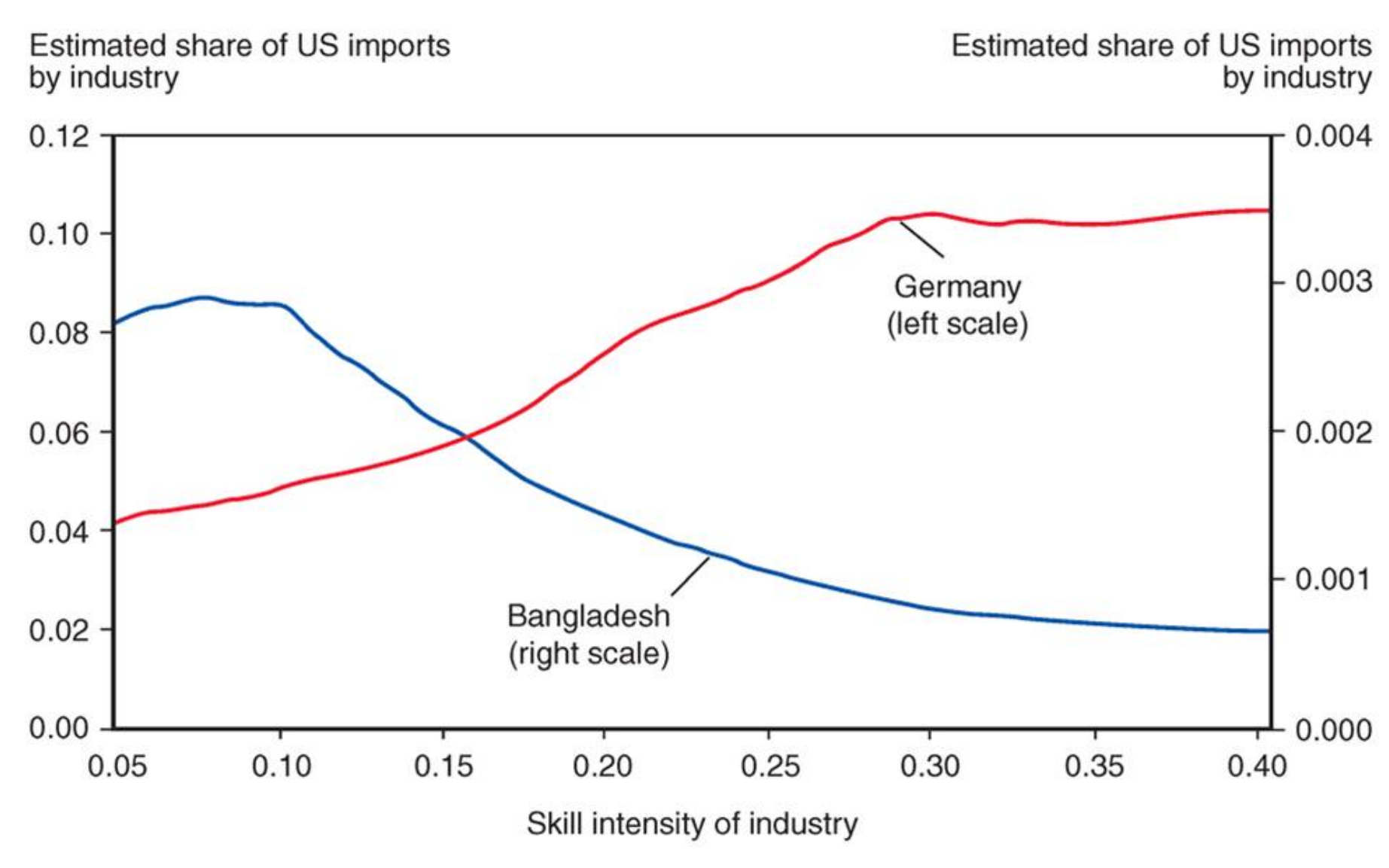
Effective Factor Endowment

- Using effective factor endowments resolves some of this puzzle
  - Effective labour supply in the U.S. is much larger than the 5% share of world supply of workers
- Caveat: a multiplicative adjustment of factor endowment is not the only way to model technological differences

Developed vs Developing Countries

- Although the HO model under standard assumptions cannot explain trade patterns, it does perform well under specific cases
- It performs well when comparing the exports of developed countries with an abundance of skilled labour and developing countries short on skilled labour

Developed vs Developing Countries



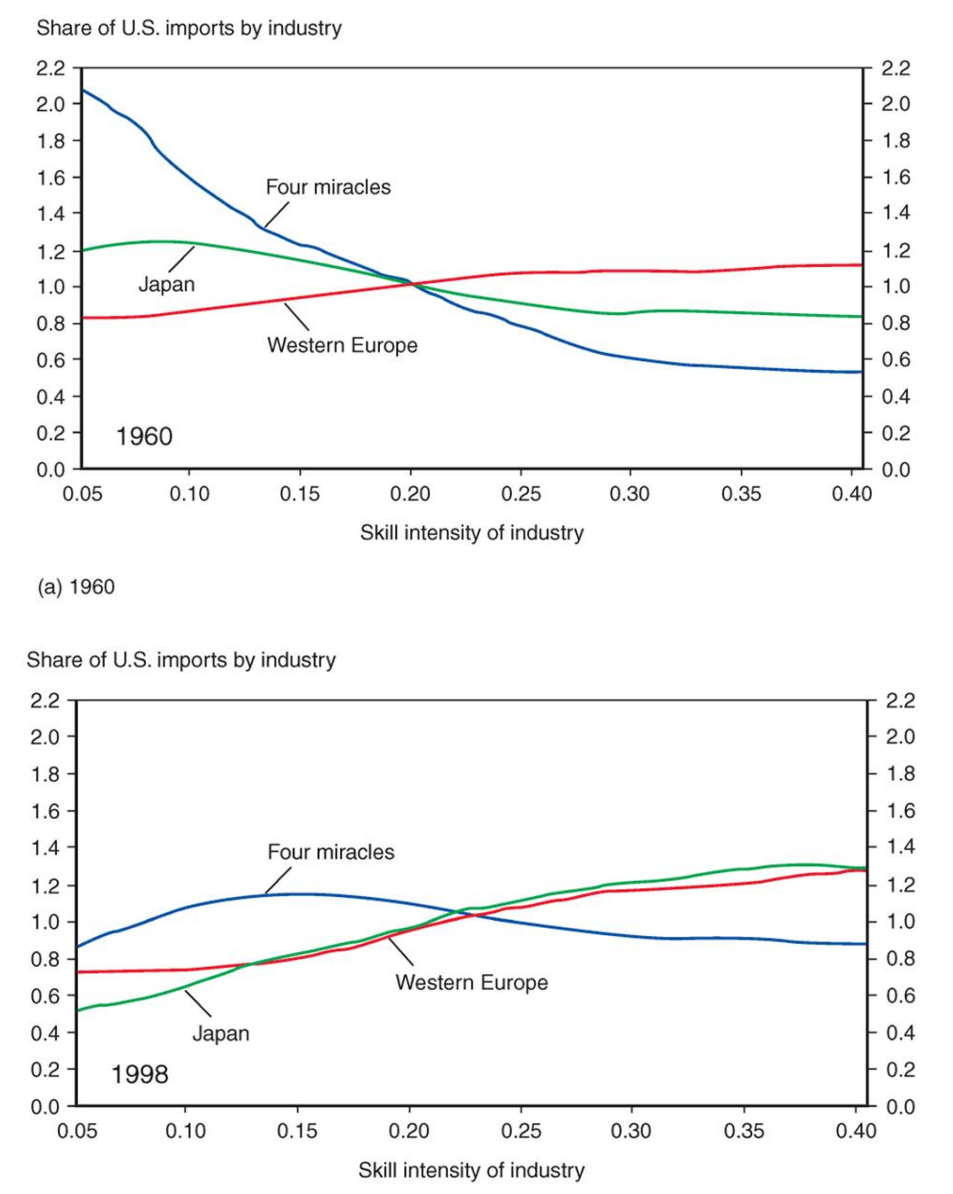
Developed vs Developing Countries

- Bangladesh accounts for a relatively large share of U.S. imports of low-skill-intensity goods, such as clothing
- Germany accounts for relatively large share of high-skill-intensity goods

Developed vs Developing Countries

- The model also performs well when looking at changes in factor endowments and trade patterns over time

Developed vs Developing Countries



Developed vs Developing Countries

- Four miracles: South Korea, Taiwan, Hong Kong, and Singapore
  - Poor countries in the 1960s
  - More high skilled in 1998
- Japanese exports titled towards low-skilled industries in the 1960s
  - But level of education of workforce equivalent to Western Europe in 1998
- Four miracles moved to the level of Japan a few decades earlier
- As supply of skilled labour increased, these asian countries began specializing more in skill-intensive goods—exactly the prediction the HO model.

Conclusion

- The predictions of the HO model seem to raise more questions than it answers
  - The model performs poorly when taken to the data
  - Factor content of a country's export does not always reflect that country's abundant factors
  - Volume of trade is substantially lower than predicted
- But does well when comparing high skill vs low skill countries and when looking at changes in factor endowment over time
- Next:
  - Specific Factors Model