ECO364: International Trade Theory

Lecture 4

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- Last Class
  - Three theorems in the HO model

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- Today
  - Factor Price Equalization
  - Factor Content of Trade

- Last Class
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- Today
  - Factor Price Equalization
  - Factor Content of Trade
- Readings
  - None!

HO Model and Factor Price Equalization

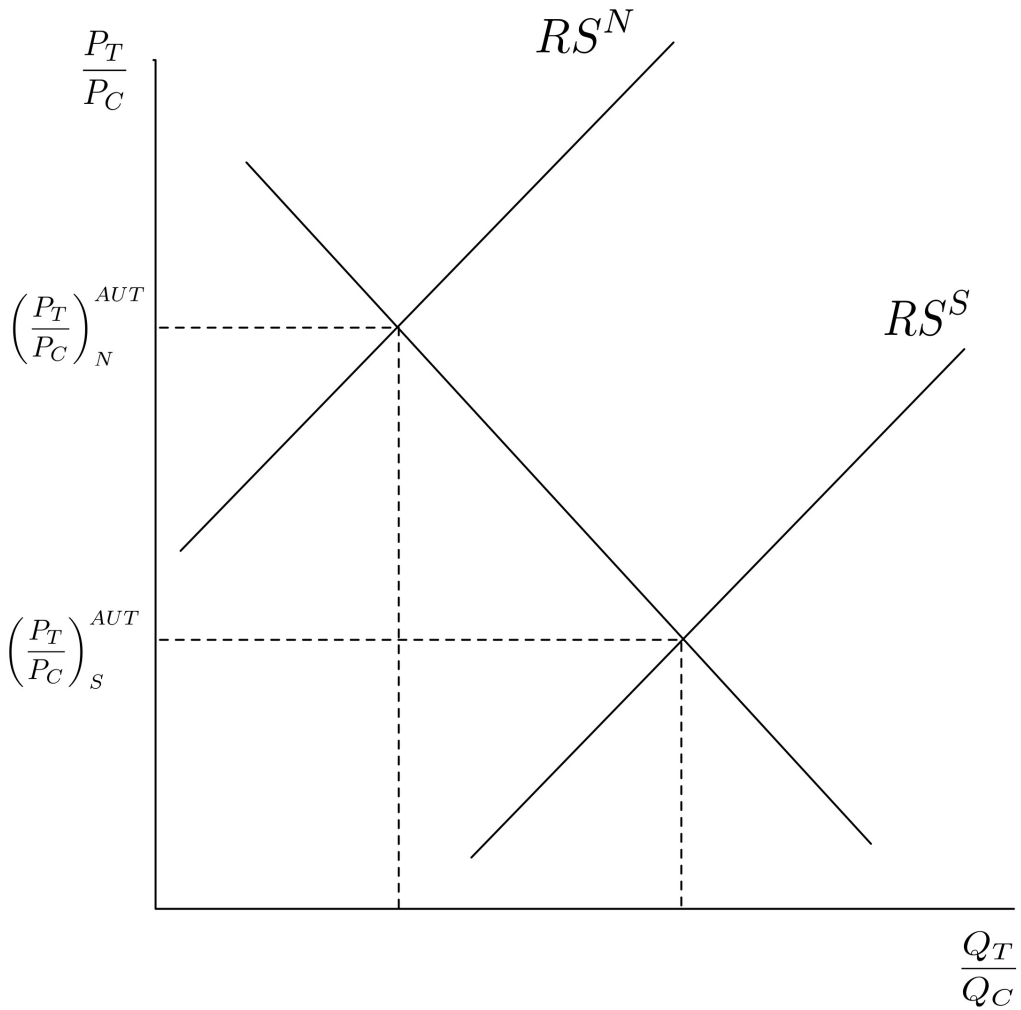
- Based on a country's factor endowments we were able to predict
  - that capital abundant countries export capital intensive goods and import labour intensive goods
  - that the return to capital owners in this country increases while the return to labour owners decreases
  - that the opposite result arises in the labour abundant country
    - return to capital owners decreases and 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)**
- To see this more clearly

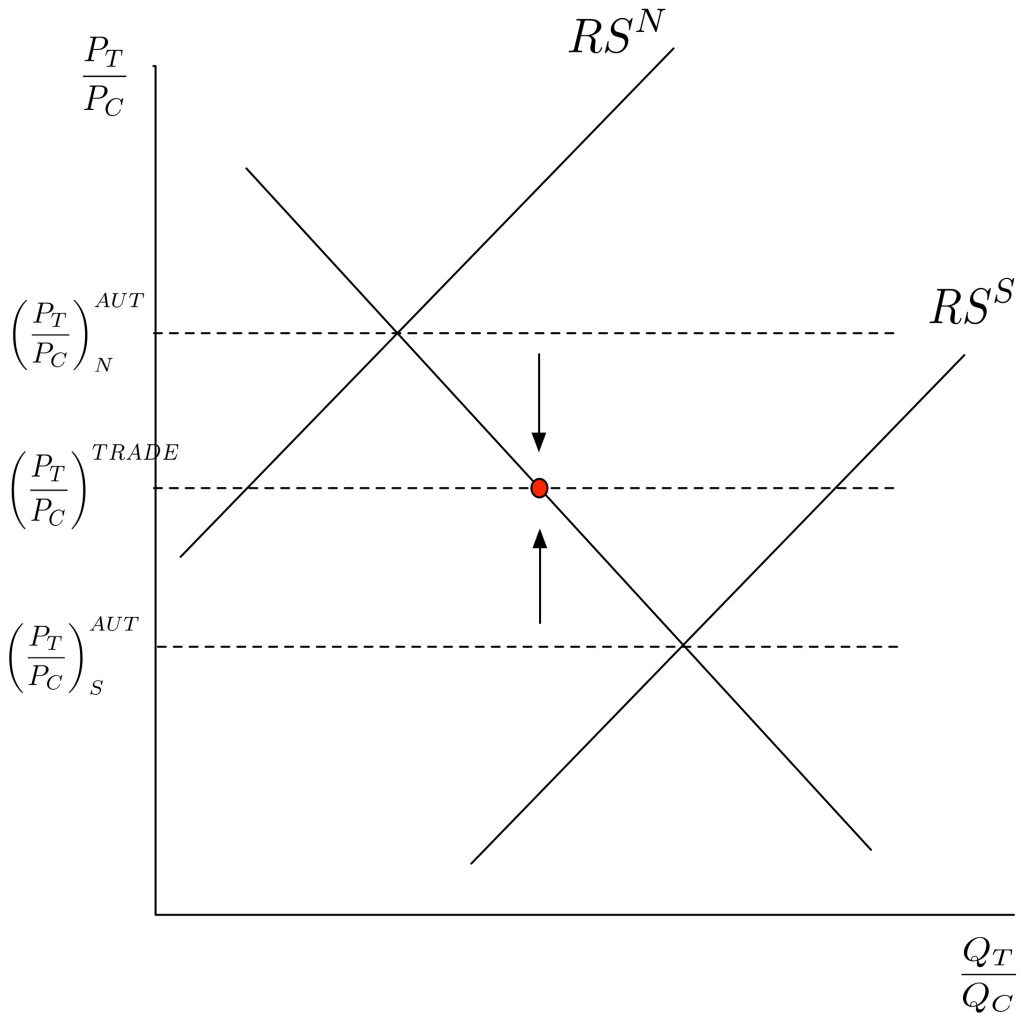
RS-RD in Autarky

Recall that the autarky relative price in each country is determined by the RS-RD graph



FPE

Under free trade, the two countries' relative good prices converge as cross-country differences in prices of goods is arbitraged away



FPE

- Since the two countries share the same SS curve, the convergence in their relative goods prices results in a convergence in their relative factor prices
- If we had skilled and low-skilled labour as the two factors in our production, this result suggests that if skilled workers make double the pay of low-skilled workers in Canada, then with free trade, skilled workers will also get paid double the wage of low-skilled workers in Mexico

FPE

- Why is this happening?
  - We assumed that factors cannot move across countries
- The goods that countries trade embody the factors used in the production of those goods
- Because of this, trade in final goods is similar to trade in the factors used in the production of those goods

FPE

- For example, a capital abundant country exports capital-intensive goods and imports labour intensive goods
- One could interpret this as exporting capital and importing labour
- Empirical studies of the HO model is also called **factor content studies**

Factor Content Studies

- Looks at 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 (net) imports embody
- For now we will focus on just two factors: skilled and unskilled labour
  - But researchers in practice include as many factors as possible in their study

Definitions and Notations

- Suppose there are two factors (skilled and unskilled labour)
- There are only two goods: computers and textiles
- Suppose the North exports computers and the South exports textiles
- Let
  - X_C^N: Northern exports of computers to the South
  - X_T^S: Southern exports of textiles to the North
  - 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

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

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

- These are just the number of skilled/unskilled labour used per unit of computers in the North

Unit Labour Requirements

- $a^S_{S,T}$: unit skilled labour requirement for textiles in the South
- $a^S_{U,T}$: unit unskilled labour requirement for textiles in the South

$$Q^S_T = \frac{1}{a^S_{S,T}} S^S_T \implies a^S_{S,T} = \frac{S^S_T}{Q^S_T}$$

$$Q^S_T = \frac{1}{a^S_{U,T}} U^S_T \implies a^S_{U,T} = \frac{U^S_T}{Q^S_T}$$

- These are just the number of skilled/unskilled labour used per unit of textiles in the South

Unit Labour Requirements

- Notice that the right hand side of these unit labour requirements are variables that we can observe 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

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

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

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

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

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

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

Example

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

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

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

- Recall North is an exporter of computer and South is an exporter of textiles

Example

- Given these values North will end up importing 1 unit of unskilled labour and exporting one unit of skilled labour
  - EXERCISE
- This leads to $\tilde{S}^N = 199$, $\tilde{U}^N = 101$, $\tilde{S}^S = 101$, $\tilde{U}^S = 199$
- The larger the factor content of trade, the greater the extent to which factor prices will converge between the two country
- Unfortunately, the prediction of the theory does not fit the data well

Factor Content Studies and Data

- U.S. is one of the most advanced country in the world
- This technological superiority imply that more capital is being used per person in production compared to other countries
  - 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
  - Perhaps guided by assumption that technology is the same across countries in the HO model
  - Skilled labour and innovative entrepreneurship (low capital) v.s. large scale manufacturing (high capital)
- 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

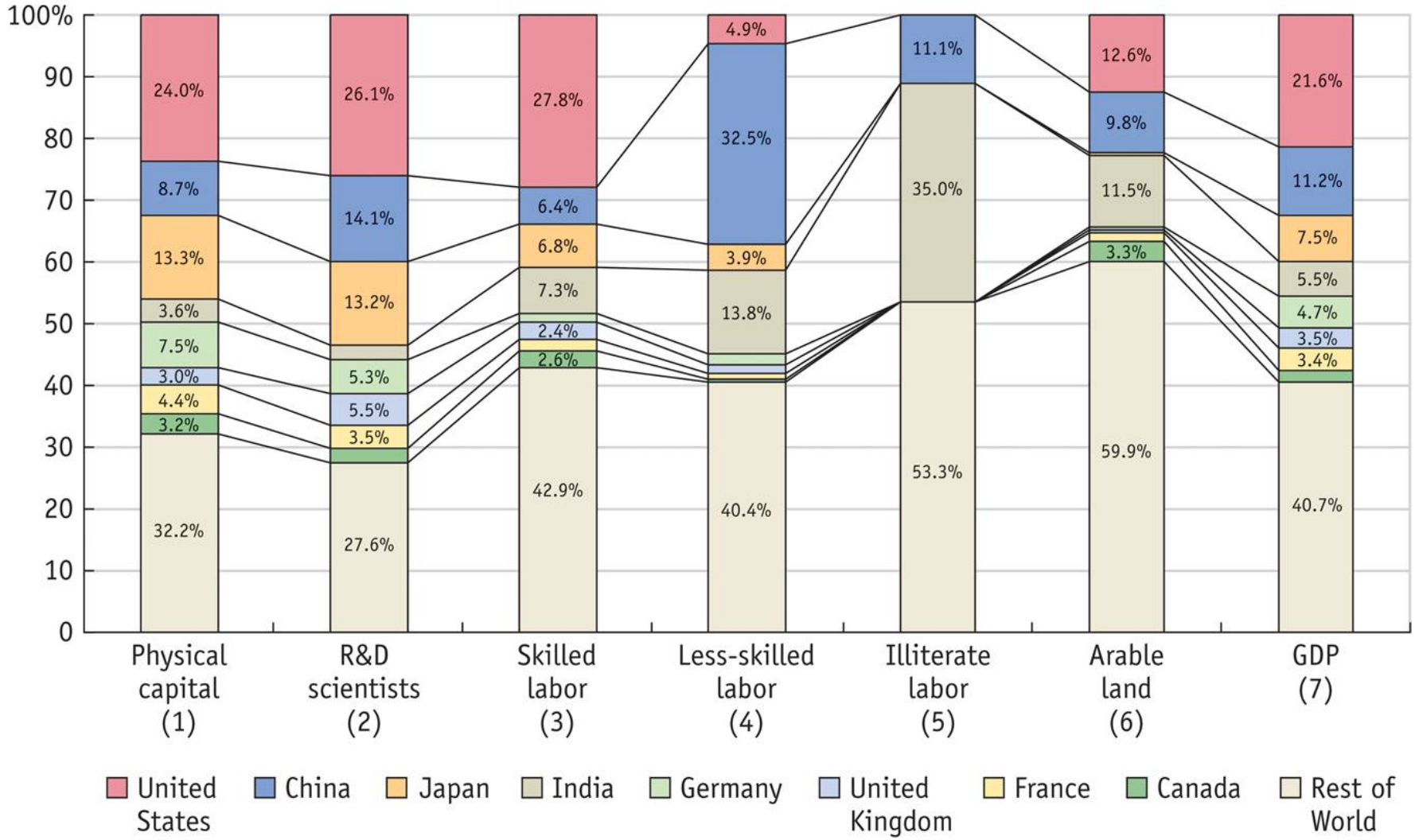
- Since the U.S. might be a special case, researchers have undertaken this study for other countries
- Instead of measuring relative factor endowment within a country, compute the country's share of a factor endowment in the whole world
- If the share of that factor is greater than the country's share 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
- According to the HO model, the country should be an exporter of the factor for which the share of the global supply of that factor exceeds the country's share of world GDP

Test on Global Data

- The country should be an importer of the factor for which their share of the global supply of that factor is less than their share of world GDP

Test on Global Data

Each country's share of global supply of each 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

- Results suggests that the HO theory based on standard assumptions have failed
- Confirms the Leontief Paradox at a more global level

The Case of the Missing Trade

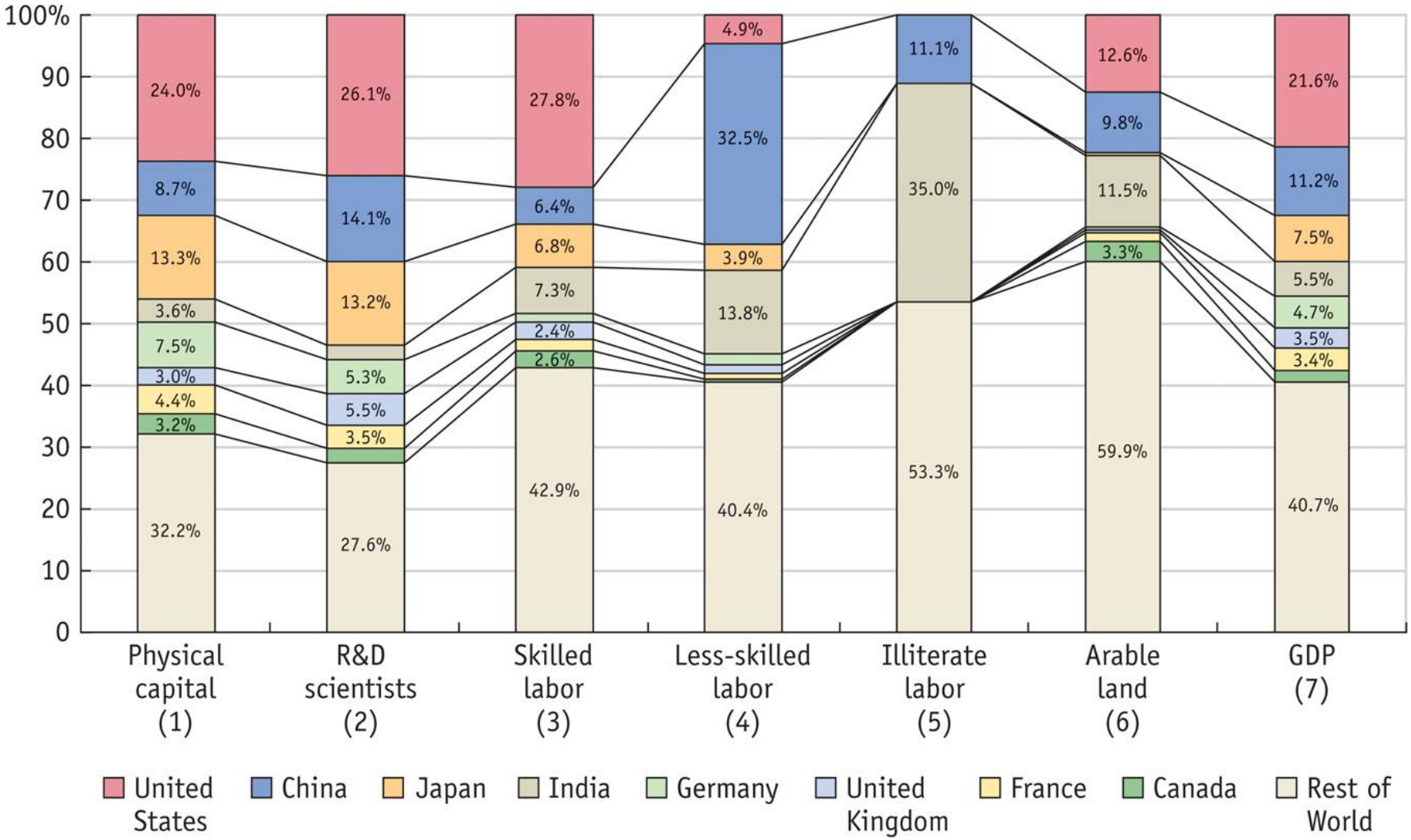
- Large differences in technology across countries might explain why the HO model is inconsistent with what is observed in the data
- Workers in more advanced countries may be more productive than workers in developing countries
- We must reconsider how we define a factor endowment

Effective Factor Endowment

- Effective Factor Endowment = Actual Factor Endowment x Factor Productivity

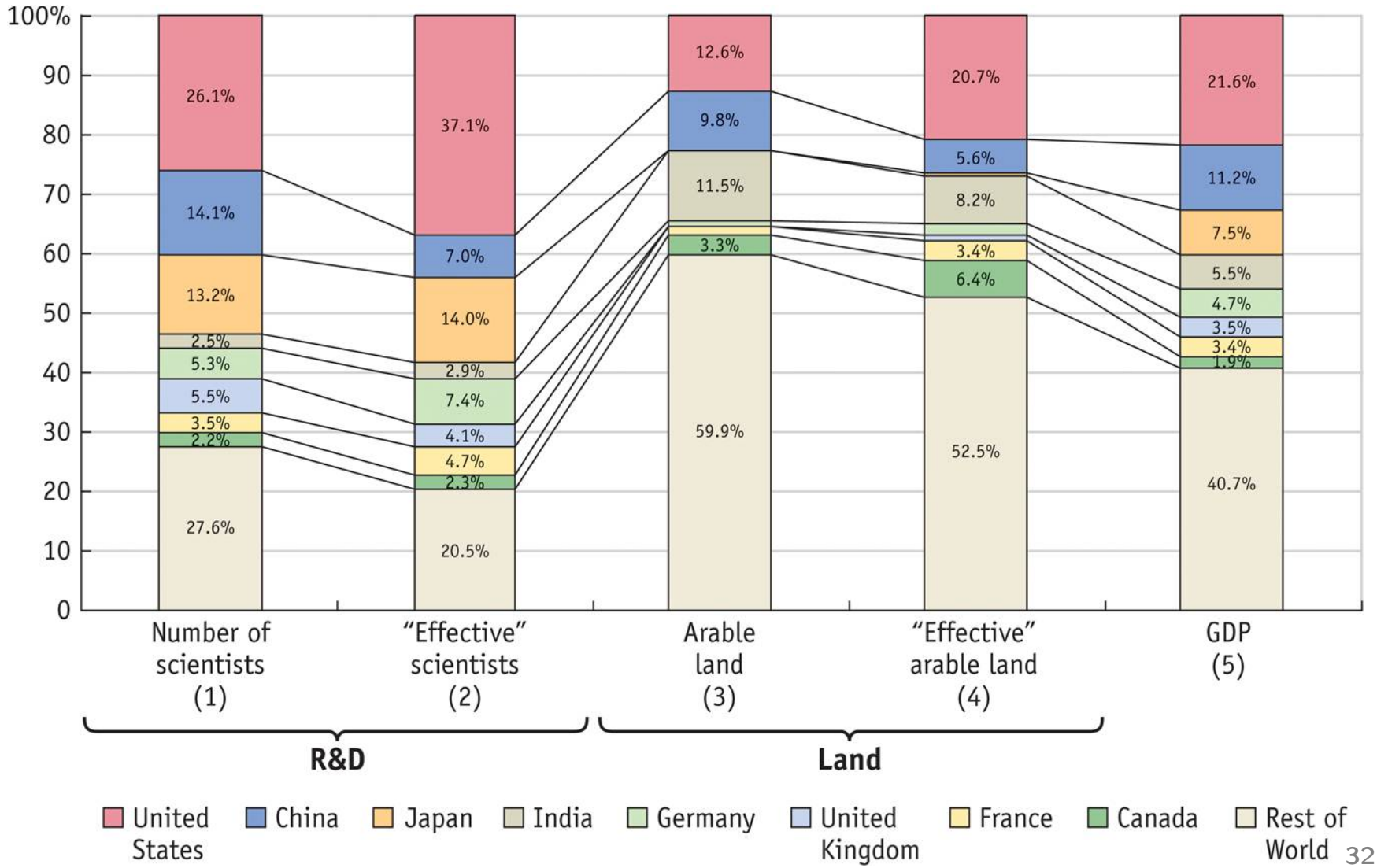
Effective Factor Endowment

Original



Effective Factor Endowment

Effective



Effective Factor Endowment

- Other issues arise when technological differences is 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

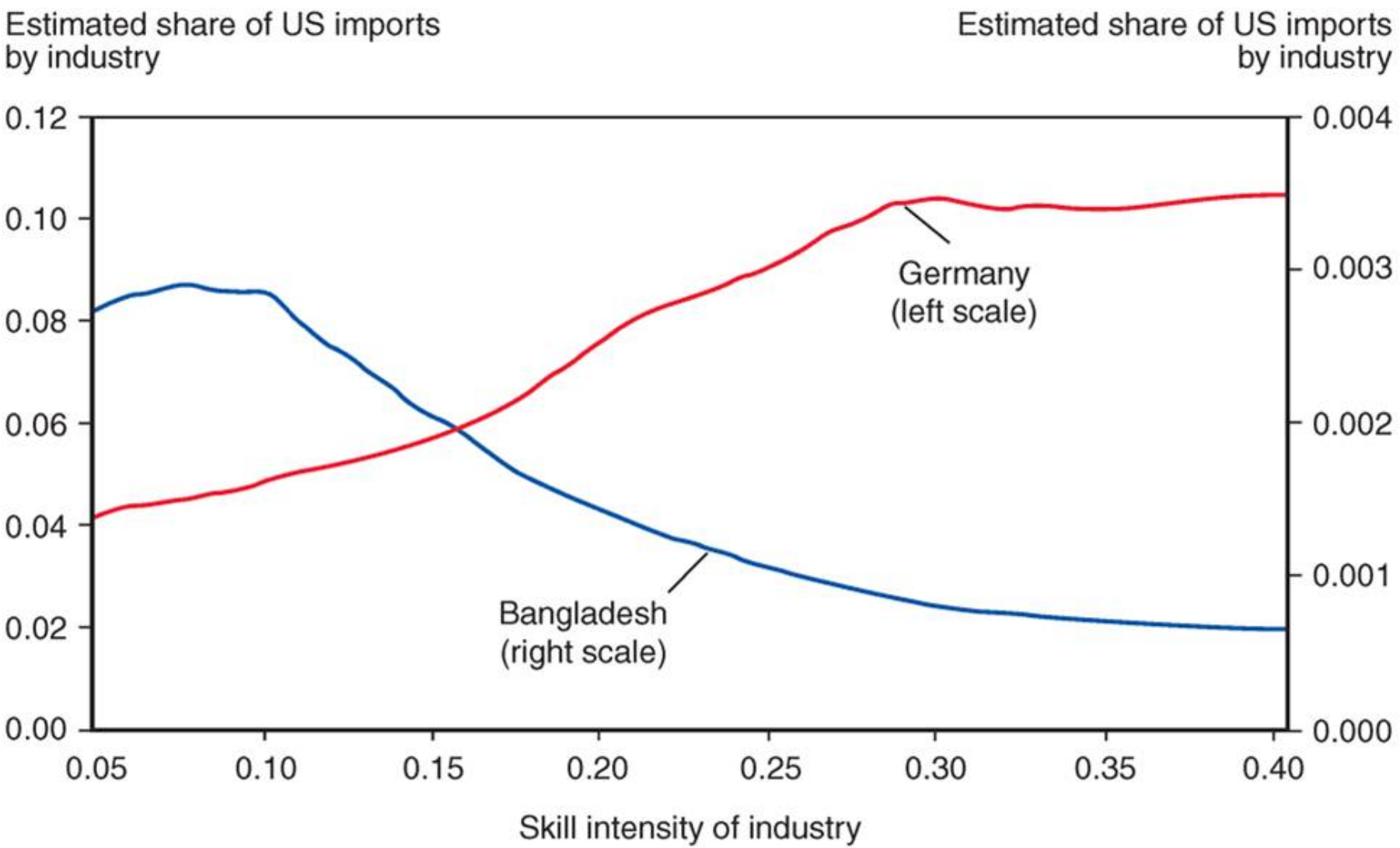
Effective Factor Endowment

- 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



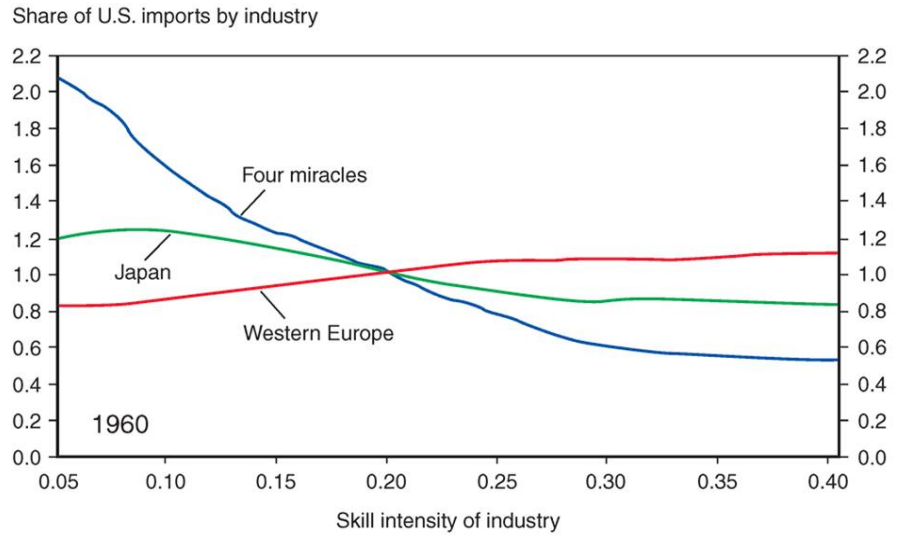
Developed vs Developing Countries

- 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

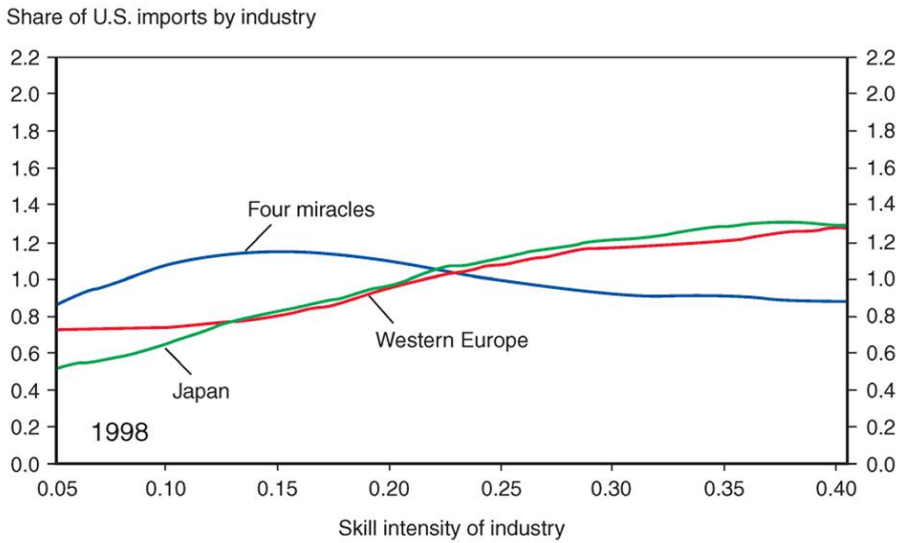
Developed vs Developing Countries

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

Developed vs Developing Countries



(a) 1960



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:
  - To what extent does FPE holds
  - Close HO model
  - Specific Factors Model