LECTURE 2: WHY DO NATIONS TRADE?

STRA 3702: International Business Environment Chang Sun

Road Map

- Comparative Advantage Models
 - The Ricardian Model: technology differences
 - The Heckscher-Ohlin Model: factor endowment
- Models with Increasing Returns to Scale
 - The Krugman Model
 - Heterogeneous firms (Melitz)
 - A case study of US-Canada Auto Pact and Chevrolet Impala

What do countries trade?

 Quiz: which are the top five goods the US exports to China? (don't look at the <u>answer</u>)

 Quiz: which are the top five goods China exports to the US? (don't look at the <u>answer</u>)

Comparative Advantage v.s. Absolute Advantage

- Some people believe that China exports toys to the US because China is more productive in producing toys than the US – trade is determined by "absolute advantage"
 - Are US toy factories really less productive?

A toy factory in China



Source: Business Insider

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A toy factory in Michigan, USA



Source: CNN

Lecture 2, STRA3702 (International Business Environment)

Comparative Advantage v.s. Absolute Advantage

- Some people believe that China exports toys to the US because China is more productive in producing toys than the US – trade is determined by "absolute advantage"
 - Are US toy factories really less productive?
 - Hard to compare, but not obvious that China is more productive in making toys
 - Adam Smith (1723-1790) had the same fallacy

Comparative Advantage v.s. Absolute Advantage



- Economists believe that an important determinant of trade patterns is "comparative advantage" (David Ricardo, 1772-1823)
 - China may not be more productive than US in making toys
 - But the productivity disadvantage is smaller comparing to other sectors such as aircrafts
 - Instead of wasting China's labor forces in making aircrafts, they should specialize in producing toys

The Ricardian Model

- Economics models make assumptions to simplify analysis and provide sharp insights
- "All models are wrong, but some are useful"
- The Ricardian Model highlights how "comparative advantage" determines trade patterns

An Example with 2 countries, 2 sectors and 1 factor

- Consider two countries, China and the U.S.
- Only two goods are produced: shirts and soybeans
- Only one production factor: labor. Both countries have 200 units of labor (200 workers)

Adam Smith's case: each country has absolute advantage in one sector

Number of Workers Required to Produce 1000 Units of Each Product

	Soybeans	Shirts
the U.S.	10 workers/1000 kg	20 workers / 1000 shirts
China	40 workers/1000 kg	10 workers/ 1000 shirts

Equivalently, Labor Productivity in Each Sector

	Soybeans	Shirts
the U.S.	100 kg / worker	50 shirts/worker
China	25 kg / worker	100 shirts/worker

- The U.S. has absolute advantage in producing soybeans.
- China has absolute advantage in producing shirts.

Absolute Advantage: production and consumption without trade

- Without trade (under "autarky"), workers need to consume both shirts and soybeans, so each country needs to produce both products
- Production and consumption patterns depend on productivities as well as consumer preferences

	Soybeans	Shirts
the U.S.	10,000 kg	5,000 shirts
China	2,500 kg	10,000 shirts

Check resource balance in each country

	Workers producing Soybeans	Workers producing Shirts	Total Resources Used
the U.S.	10000/100 = 100	5000/50 = 100	200
China	2500/25 = 100	10000/100 = 100	200

Absolute Advantage: production with trade

With trade, each country should specialize in the sector where it produce most efficiently and buy goods that it produces less efficiently from other countries

	Soybeans	Shirts
the U.S.	20,000 kg	0
China	0	20,000 shirts
Total World Production	20,000 kg	20,000 shirts

Production with Specialization

Compared to Autarky

	Soybeans	Shirts
the U.S.	10,000 kg	5,000 shirts
China	2,500 kg	10,000 shirts
Total World Production	12,500 kg	15,000 shirts

Absolute Advantage: consumption with trade

- With specialization, total world production in each sector is larger than that under autarky
- There exist many trading schemes that increase the consumption of both countries
 - E.g., suppose China trades 6,000 shirts for 6,000 kg of American soybeans

	Soybeans	Shirts
Final Consumption by the U.S.	14,000 kg	6,000 shirts
Final Consumption by China	6,000 kg	14,000 shirts
Total World Production	20,000 kg	20,000 shirts

 This is only one possible scenario. If two countries trade freely, the prices and quantity will be determined by consumer preferences (beyond the scope of this course)

David Ricardo's case: comparative advantage

Number of Workers Required to Produce 1000 Units of Each Product

	Soybeans	Shirts
the U.S.	10 workers/1000 kg	13.33 workers / 1000 shirts
China	40 workers/1000 kg	20 workers/ 1000 shirts

Equivalently, Labor Productivity in Each Sector

	Soybeans	Shirts
the U.S.	100 kg / worker	75 shirts/worker
China	25 kg / worker	50 shirts/worker

The U.S. has absolute advantage in both sectors!

Comparative Advantage: production and consumption without trade

	Soybeans	Shirts
the U.S.	10,000 kg	7,500 shirts
China	2,500 kg	5,000 shirts

Check resource balance in each country

	Workers producing Soybeans	Workers producing Shirts	Total Resources Used
the U.S.	10000/100 = 100	7500/75 = 100	200
China	2500/25 = 100	5000/50 = 100	200

Comparative Advantage: production with trade

	Soybeans	Shirts
the U.S.	15,000 kg	3,750 shirts
China	0	10,000 shirts
Total Production	15,000 kg	13,750 shirts

Check resource balance in each country

	Workers producing Soybeans	Workers producing Shirts	Total Resources Used
the U.S.	15000/100 = 150	3750/75 = 50	200
China	0	10000/50 = 200	200

Compared with Autarky

	Soybeans	Shirts
the U.S.	10,000 kg	7,500 shirts
China	2,500 kg	5,000 shirts
Total Production	12,500 kg	12,500 shirts

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Comparative Advantage: consumption with trade

- Similar to the earlier case, total world production with specialization in each sector is larger than that under autarky
- There exist many trading schemes that increase the consumption of both countries
 - E.g., suppose China trades 4,000 shirts for 4,000 kg of American soybeans

	Soybeans	Shirts
Final Consumption by the US	11,000 kg	7,750 shirts
Final Consumption by China	4,000 kg	6,000 shirts
Total World Production	15,000 kg	13,750 shirts

• This is only one possibility. If two countries trade freely, the prices and quantity will be determined by consumer preference (beyond the scope of this course)

Gains from trade

 We can prove that there is gains from trade for both country by examining the opportunity costs

	Soybeans	Shirts	Opportunity costs of 1000 shirts by domestic production	The Price of Trade
the U.S.	10 workers /1000 kg	13.33 workers / 1000 shirts	1000 shirts = 13.33 workers = 1333 kg soybeans	1000 shirts = 1000 kg
China	40 workers /1000 kg	20 workers / 1000 shirts	1000 shirts = 20 workers = 500 kg soybeans	soybeans

- The current trading scheme is 1000 shirts for 1000 kg soybeans
- Good deal for the U.S. since the production cost of 1000 shirts is 1333 kg soybeans, larger than the costs of trade with China (1000 kg soybeans)
- Good deal for China since the production cost of 1000 kg soybeans is 2000 shirts, larger than the costs of trade with the U.S. (1000 shirts)
- The price of trade must be between $\frac{1000 \text{ shirts}}{1333 \text{ kg soybeans}}$ and $\frac{1000 \text{ shirts}}{500 \text{ kg soybeans}}$

What does the Ricardian model miss?

- Some of the model assumptions can be relaxed and the conclusion is largely unchanged
 - 2 countries * 2 sectors \rightarrow many * many
 - Zero trade costs \rightarrow realistic trade costs
 - Full employment
- Some of the model assumptions are more crucial
 - a. Single factor (Heckscher-Ohlin Model)
 - b. Workers adjust freely between sectors (Lecture 3)
 - c. Efficiency in each sector is fixed they can change if a country produces more (Lecture 5)
- Overall, the Ricardian model provides a strong argument for trade liberalization

Misconceptions about Ricardian Comparative Advantage

- 1. Free trade is beneficial only if a country is more productive than foreign countries
 - This is saying only the country with absolute advantage gains. But we only need comparative advantage to gain from trade.
- 2. Free trade with countries that pay low wages hurts high wage countries.
 - We have not discussed what determines wages. Usually the country with absolute advantage has higher wages, but we have shown that it is comparative advantage that matters
- 3. Free trade exploits less productive countries whose workers make low wages
 - We have shown that the gain is realized from voluntary participation in trade. The countries can always go back to autarky.
- These claims may be correct in other trade models! (Heckscher-Ohlin Model next, and also Lecture 3)

Ulam's Challenge and Samuelson's Response

- Ulam, a mathematician, once asked
 - "name one proposition in all of social sciences which is both true and non-trivial"
- Economist Samuelson's response: comparative advantage
 - "That it is logically true need not be argued before a mathematician...
 - "...that it is not trivial is attested to by the thousands of important and intelligent men who have never been able to grasp the doctrine for themselves, or to believe it after it was explained to them"
 - "few politicians ... can follow the analysis ... quotas, tariffs, and trade wars mar the world's economic history"

Implications for businesses?

- Should a company produce shirts in China?
 - The Ricardian Model can say little about this question!
- 1. If an American shirt company goes to China, does it inherit the American productivity or the Chinese productivity?
 - American productivity: if productivity is determined by the company's own technology, such as blueprints and recipes for making shirts
 - Chinese productivity: if productivity is embedded in the knowledge of the local labor force and my company hires local workers
- 2. The company should care about the absolute level of productivity, not comparative advantage
- 3. Besides productivity (output per worker), the firm also cares about worker wages, which are determined by equilibria in all sectors

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Country Differences in Factor Endowment

- The Ricardian Model assumes countries differ in "technologies"
- Countries also differ in the amount of factors endowed
 - Capital (buildings, machines, softwares, etc), labor (skilled v.s. unskilled), land, minerals, etc



Industry Differences in Factor Proportions

Factor proportions differ across industries (US manufacturing)

Most Skill-intensive Industries	Most Capital-intensive Industries
3764 Space propulsion units and parts	2111 Cigarettes
3826 Analytical instruments	2087 Flavoring extracts and syrups
3769 Space vehicle equipment	2043 Cereal breakfast foods
Least Skill-Intensive Industries	Least Capital-Intensive Industries
2111 Cigarettes	2299 Textile goods
2043 Cereal breakfast foods	3534 Elevators and moving stairways
2087 Flavoring extracts and syrups	3321 Gray iron foundries

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An example of the Heckscher-Ohlin model

- 2 countries (US, China), 2 sectors (soybeans, shirts), 2 factors (labor, land)
- Technology is different across sectors, same across countries
 - 1 labor + 3 land = 1000 kg soybeans
 - 3 labor + 1 land = 1000 shirts
- US and China are different in resource endowments
 - US is rich in land while China is rich in labor
 - Land is cheap in the US; labor is cheap in China

Costs of Factors	Land	Labor
the U.S.	\$1 pre acre	\$2 per worker
China	\$2 per acre	\$1 per worker

An example of the Heckscher-Ohlin model

Costs of Factors	Land	Labor
the U.S.	\$1 pre acre	\$2 per worker
China	\$2 per acre	\$1 per worker

Unit production cost in each sector

Costs for 1000 units	Soybeans		St	nirts		
	Land costs	Labor costs	Total	Land costs	Labor costs	Total
the U.S.	\$1*3	\$2*1	\$5	\$1*1	\$2*3	\$7
China	\$2*3	\$1*1	\$7	\$2*1	\$1*3	\$5

The U.S. has comparative advantage in producing soybeans.

China has comparative advantage in producing shirts.

Comparative advantage in the Heckscher-Ohlin model

- Differences in endowments generate "comparative advantage"
- An economy tend to have comparative advantage in sectors where the **abundant** factor is used **more intensively**

Trade and Inequality

- Soybean is relatively cheap in the U.S. under autarky
- If US and China open to trade, large demand in China in soybeans will drive up its price in the US.
- Meanwhile, Chinese exports in shirts will lower their price in the US.
- Since land is more intensively employed in soybeans, higher price of soybeans after trade will
 - Benefit US land owners; hurt US labor
- Similarly, trade will
 - Benefit Chinese labor; hurt Chinese land owners
- Trade tend to benefit the abundant factor, and hurt the scarce factor.
- Under many conditions, one can show that the government can transfer income between factors to make everyone better off, but:
 - Hard to implement
 - Taxes and subsidies distort incentives

Is there a link between trade and inequality?

- HO Model says yes
 - US is abundant in skilled labor and capital. They should benefit from trade and unskilled labor should lose
- Hard to find statistical evidence (see the Economist article, "Krugman's conundrum")
 - One popular way to estimate how trade has affected different factors is to calculate the "factor content" in net import (= import – export)
 - If US imports shirts and exports soybeans, then the "labor content" in net import is positive, "land content" in net import is negative
 - Foreign "workers" are replacing US "workers", while US "land" is replacing foreign "land" in producing soybeans
- Economists find these numbers to be small!
 - Krugman (1995): trade explains 1/10 of the widening gap between skilled and unskilled workers in the US

No link between trade and inequality? Why?

- Possibility 1: looking at the data from the wrong angle
 - Some researchers look at the data in a different angle and find different results (Lecture 3)
- Possibility 2: many non-trade factors that affect inequality
 - Skill-biased technological change: computers increase the relative productivity of skilled workers
 - E.g., according to HO Model, inequality in China should have declined due to trade; we see the reverse
- Possibility 3: trade may have increased inequality; but the mechanisms are different from the HO Model (related to 1)

Implications for businesses

- When choosing location of production, factor prices are important considerations
- Factor prices are closely linked to the abundance of the factors
- Factor prices may change as countries accumulate factors
 - Population growth/aging
 - Education can increase worker skills
 - Investment can increase capital stock
- Who might be pro/against trade? Will consumers protest against companies' strategies? What about governments? (Lecture 3)

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Failure of comparative advantage models to explain "intra-industry" trade

- Both Ricardian and Heckscher-Ohlin models predict that import and export must be in different industries
 - US import clothes, export soybeans (inter-industry trade)
- However, US exports cars to EU and EU exports cars to US (intra-industry trade)
- Index for intra-industry trade for a particular industry $I = \frac{min\{exports, imports\}}{(exports + imports)/2}$
 - if only exports or imports, then I = 0
 - if exports = imports, then I = 1

KOM Table 8-2: Indexes of Intra-Industry Trade for U.S. Industries, 2009

Metalworking Machinery	0.97
Inorganic Chemicals	0.97
Power-Generating Machines	0.86
Medical and Pharmaceutical Products	0.85
Scientific Equipment	0.84
Organic Chemicals	0.79
Iron and Steel	0.76
Road Vehicles	0.70
Office Machines	0.58
Telecommunications Equipment	0.46
Furniture	0.30
Clothing and Apparel	0.11
Footwear	0.10

Krugman: Increasing Returns to Scale

- Both Ricardian and HO models assume "constant returns to scale"
 - Double output requires double all inputs, thus double total costs
 - Average cost is constant
- Real-world production may feature "increasing returns to scale" (or "economies of scale")
 - Double output requires less than double costs
 - Average costs decline as output increases

A numerical example of increasing returns to scale

- To produce any shoes, need to employ at least 5 workers
- To produce one more pair, need to employ one additional worker
- Total employment as a function of quantity produced? L(Q) = 5 + Q
- Average labor input per pair of shoes L(Q)/Q = 5/Q + 1

Pairs of shoes	Total labor input	Average labor input
5	10	2
10	15	1.5
15	20	1.333

Causes of Increasing Returns to Scale

- Large upfront costs of production
 - Building plants, setting up production lines, etc
 - Inventing/designing and marketing products
- E.g., average cost of drug development is USD 4 billion (major pharmaceutical companies, 1997-2011)
 - Manufacturing costs are much smaller

The example of shoe production

- Suppose the wage rate is \$1 per worker
- To start production, need to employ 5 workers \rightarrow \$5
- To produce one additional pair, need to pay \$1
- Total costs (TC)

$$TC(Q) = 5 + Q$$

Average costs (AC)

AC(Q) = 5/Q + 1

Marginal costs (MC)

MC = TC(Q+1) - TC(Q) = 1

MC and AC on a graph



Other ingredients of the Krugman model

- Each firm pays some upfront costs and produces a differentiated product
 - In Ricardian and HO models, firms in an industry produce exactly the same product
- Consumers like to consume different varieties
 - E.g., shoes (Nike, Adidas, Reebok, Asics, ...)
- Increasing returns to scale + love of varieties \Rightarrow

intra-industry trade between similar countries with no comparative advantage differences

Gains from Trade in the Krugman Model

- Without trade, if consumers in both US and Germany want to wear Nike shoes, there needs to be a plant in each country ⇒ pay fixed costs twice
- With trade, Nike can produce in the US and export to Germany ⇒ pay fixed costs once
- The resources saved from duplicating plants can be used to create new varieties (variety effect)









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Heterogeneous Firms and Trade (Melitz, 2003)

- Exporters are rare and different from non-exporters
 - Only 4% of US firms export (Bernard et al., 2007)
 - Exporters are larger and more productive
- Melitz (2003) adds firm differences in productivity into the Krugman model
- Additional Gain from Trade: competition effect
 - After opening to trade, more productive firms serve both home and foreign markets
 - Better-performing firms expand; worse ones contract
 - Overall industry performance improves
- Evidence supports the competition effects
 - Trade liberalization in countries such as Canada, China, Chile, etc

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Case study: US-Canada Auto Pact and Chevrolet Impala

US-Canada Auto Pact

- Before 1965, auto sectors in US and Canada were protected by high tariffs
- In 1965, US and Canada signed the Auto Pact eliminated tariffs on autos and parts
- Side agreement: US firms continue to produce in Canada
- GM used to produced Chevrolet Impala in both US and Canada
- Today, all Chevrolet Impala are produced in Canada

An iconic American car





1961 Impala Convertible, produced in both US and Canada Source: <u>Wikipedia</u> 2003 Impala LS, produced only in Canada Source: <u>Wikipedia</u>

Relevance of Increasing Returns to Scale

- Total costs to produce in both US and Canada $TC(Q) = 2 \times Fixed \ costs + c \times Q$
- Total costs to produce in either US or Canada $TC(Q) = Fixed \ costs + c \times Q$
- Since the Auto Pact requires GM to continue to produce in Canada, it is natural to produce only in Canada
- The proximity-concentration trade-off for multinationals
 - Producing close to consumers can reduce transportation costs
 - However, concentrating production in one place reduces the upfront costs

An update on Chevrolet Impala

- The car is only made in the GM factory in Oshawa, Canada
- In Nov, 2018, GM announced its plan to close the Oshawa factory, along with two factories in the US
 - Sales of sedans have been declining for several years
 - GM wanted to focus on trucks, SUVs, electric and selfdriving cars in the US
- GM is still producing other sedans in many locations, including China



Donald J. Trump 🤣 @realDonal... · 23m 🗸

....for electric cars. General Motors made a big China bet years ago when they built plants there (and in Mexico) - don't think that bet is going to pay off. I am here to protect America's Workers!

♀ 2,703 1,837 ♥ 14.1K ↑
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Donald J. Trump ② @realDonal... · 23m ~ Very disappointed with General Motors and their CEO, Mary Barra, for closing plants in Ohio, Michigan and Maryland. Nothing being closed in Mexico & China. The U.S. saved General Motors, and this is the THANKS we get! We are now looking at cutting all @GM subsidies, including....

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Summary

- Comparative Advantage Models
 - Differences in technologies or factor endowments drive inter-industry trade
 - Gain from specialization and cheaper products
 - Impact on income inequality
- Models with Increasing Returns to Scale
 - Increasing returns to scale + love of variety drive intraindustry trade between similar countries
 - Gain from new varieties and reallocation between betterand worse-performing firms
 - Proximity-concentration trade-offs

US Exports to China

HTS4 Code	Product Description	Value (Billion US\$)
1201	Soybeans	11.69
8800	Civilian Aircraft, Engines, and Parts	8.87
8703	Motor Cars and Other Motor Vehicles to Transport People	5.84
8542	Electronic Integrated Circuits and Microassemblies	3.65
7404	Copper Waste and Scrap	2.20

Source: <u>US International Trade Commission</u>. US domestic exports to China, 2008-2016 average, 4-digit Harmonized Tariff Schedule (HTS)



Lecture 2, STRA3702 (International Business Environment)

China Exports to US

HTS4 Code	Product Description	Value (Billion US\$)
8471	Automatic Data Processing Machines; Magnetic Or Optical Readers	46.55
8517	Electrical Apparatus for Line Telephony	43.85
8528	Television Receivers; Video Monitors	12.47
9503	Toys and Parts	9.88
8473	Parts and Accessories for Typewriters and Other Office Machines	9.60

Source: <u>US International Trade Commission</u>. US general imports from China, 2008-2016 average, 4-digit Harmonized Tariff Schedule (HTS)



Lecture 2, STRA3702 (International Business Environment)