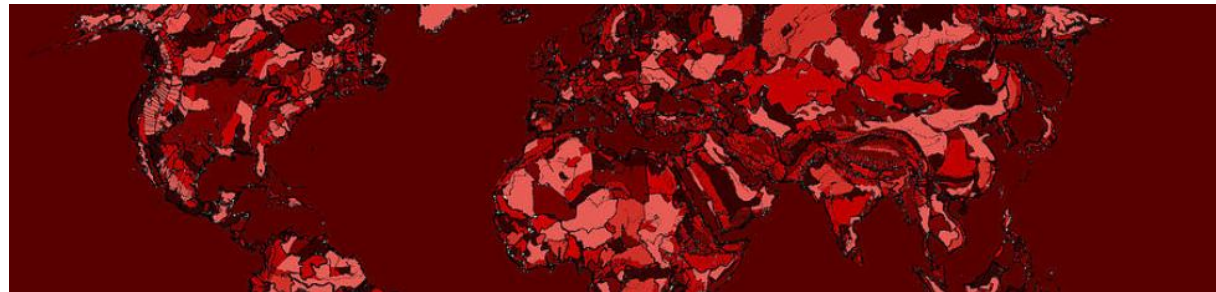# STA501: Data-based Decision Making

Lecture 1: Comparative Advantage

Swiss Institute of
Artificial Intelligence

Opportunity cost is a true (but invisible) cost
- Opportunity cost arises due to scarcity of resources, which results in trade-offs in decision making

Scarcity, Trade-off, Opportunity cost	Opportunity cost in example

Scarcity

■ Resources are scarce, but we have unlimited wants

■ The real limit is the scarcity of productive resources
   – Labor, capital, land, and entrepreneurship

Trade-off

■ People face trade-offs in every decision in life
   – Time, income, goods, house, etc
   – When decisions are made, people are always confronted with multiple alternative actions
      – Waking up for work, school…

■ The ultimate decision should be the most efficient, profitable outcome

Opportunity cost

■ The foregone benefit of the **next best alternative** when resources are used for one purpose rather than another

■ What you are missing out on because of the activity you chose to partake in

Explicit vs. Implicit costs

■ Explicit – what you pay for sth (ex. money, time…)

■ Implicit – opportunity cost of using your resources rather than selling them to someone else

■ Going to a school vs. spend money and time for sth else in life (ex. work, traveling, doodling…)
   – Among all other choices not chosen, the (personally) most valuable choice is your opportunity cost of going to a school

■ Example
   – Going to a college
      – Tuition: CHF 40,000 / Year
      – Duration: 3 Year
   – If worked
      – Salary: CHF 80,000 / Year
   – What is the explicit cost? What is the implicit cost?
   – What is the opportunity cost? What is the total cost?

Absolute advantage vs. Comparative advantage

- Not intuitive, but comparative advantage does explain a number of economic choices

Absolute vs. comparative advantage explained

Absolute advantage

- "The natural advantages which one country has over another in producing particular commodities are sometimes so great that is acknowledged by all the world to be in vain to struggle with them"
  - Adam Smith "Wealth of Nation", Chapter 2
  - Simply put, you are <u>efficient</u>
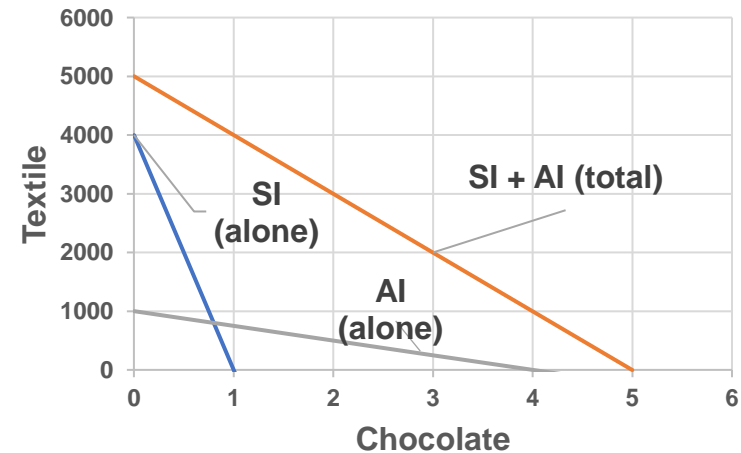
Comparative advantage

- A country's ability to produce a good at a <u>lower opportunity cost</u> than another country
  - David Ricardo's argument to defend "Corn Law"
- Why comparative than absolute?
  - Limited resources (land, labor, capital…)
  - Technological differences, climate,…
  - Even if you are efficient, you don't have infinite resources to do everything. You are only human
- Division of labor, HR allocation, international trade…

Example – w/o trade vs. w/ trade

Without trade vs. with trade

- SI can produce 4,000 yards of textile per day or 1 ton of chocolate per day
- AI can produce 1,000 yards of textile a day or 4 tons of chocolate per day
- SI's CA is textile, and AI's CA is chocolate
- Then, production possibilities are

- SI and AI specialize in one's expertise and trade, then the aggregate output is larger (thus more efficient)

Gains from specialization
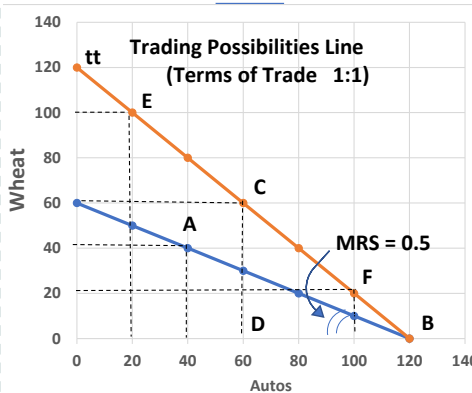- How division of labor explains trade (and other economic choices)

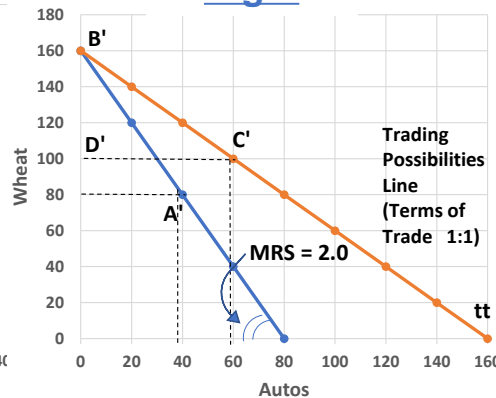## Marginal rate of substitution (MRS)

Definition of MRS

■ Amount of one good a country must sacrifice to get one more unit of another good (i.e. opportunity cost)

$$MRS = \left| \frac{\Delta \text{ good Y}}{\Delta \text{ good X}} \right|$$

Left   **Right**

■ 1 more auto in Left = 0.5 less wheat

■ 1 more auto in Right = 2 less wheat

■ The left specializes in autos (due to lower opportunity cost), and the right specializes in wheat

W/ and w/o specialization

	Before Specialization		After Specialization	
	Autos	**Wheat**	**Autos**	**Wheat**
Left	40	40	120	0
Right	40	80	0	160
Total	80	120	120	160

■ Specialization yields more production in total

■ Depending on each part's needs for the other good, the (relative) price will be determined in trade

■ An example trade case

	Before Trade		After Trade	
	Autos	**Wheat**	**Autos**	**Wheat**
Left	40	40	60	60
Right	40	80	60	100
Total	80	120	120	160

■ Could be any team work for division of labor

■ The tricky part is, if they agree with the given price…

Extension 1. Dynamics of comparative advantage

- If one party disagrees the price and capable of turning the table…
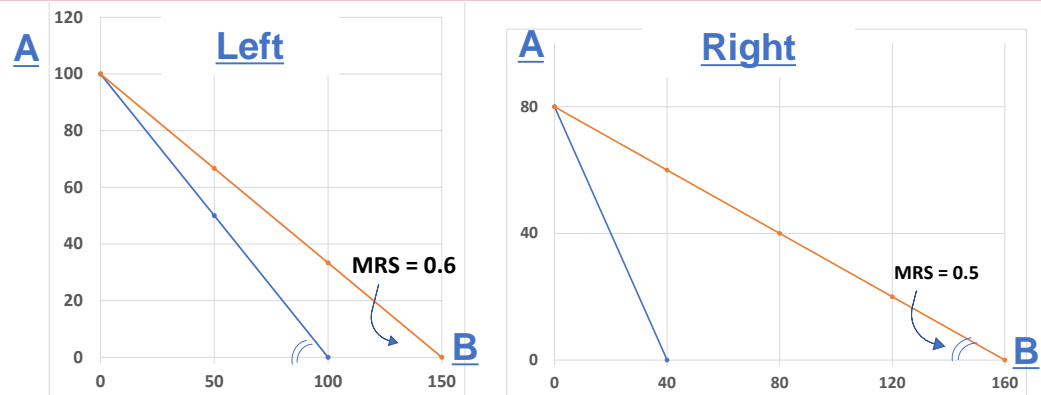
Terms of trade estimate

$$\text{terms of trade} = \frac{\text{export price index}}{\text{import price index}} \times 100$$

- Prices of exports rise in relation to imports shows improvement in terms of trade
- Another index of a country's competitiveness
- 2006 terms of trade data using 2000 as base year

Country	Export Price Index	Import Price Index	Terms of Trade
Australia	174	120	145
Canada	138	124	111
China	101	97	104
Switzerland	145	148	98
United States	111	115	97
Brazil	144	149	97
Japan	95	127	75
South Korea	92	126	73

Source: https://tcdata360.worldbank.org/indicators/h62a3e8cc

Dynamics of comparative advantage

- Relative price (or opportunity cost) can change over time, therefore comparative advantage could shift

Q. Can increased productivity of a firm be translated to more market share in the presence of international trade?

- A firm could lose market share if another sector in the economy is relatively more productive than the other industry
- Changing dynamics in productivity within country alters
  - Allocation of labor / capital / land within country
  - Relative productivity of a sector to the global market
  - Relative domestic / global market share of a sector

Extension 2. Many goods
- Relative productivity vs. Relative wage

Many goods case

Relative pricing fails
- Which is a common denominator (numerator good)?
- Instead focus on <u>relative productivity</u>
- Need an anchor for pricing all goods
  - e.g. number of hours (L) x hourly wage (W)
  - Cost of production for good i = WL_i
  - The counterparty's productivity = $W^*L^*_i$
    - * for counterparty

Cases
- $WL_i < W^*L^*_i$ or $L^*_i / L_i > W / W^*$
  - Good i should be produced in home, otherwise, it should be the counterparty to produce

Rationale
- $L^*_i / L_i = (1/L_i) / (1/L^*)$
  - Is the relative productivity which is compared to the relative wage (i.e. cost) W / W^*
  - Assuming productivity = wage

Example – France vs. Germany

Good	L_i (Fr)	L^*_i (Ge)	L^*_i / L_i	W/W*	CA
Calculator	50	20	0.4	2.5	G
Bread	1	2	2	2.5	G
Cheese	3	9	3	2.5	F
Wine	5	20	4	2.5	F
Apples	3	30	10	2.5	F

5 goods case
- Calculator, Bread – relative productivity lower than 2.5, thus Germany has comparative advantage (or France has comparative **dis**advantage)
- Cheese, Wine, Apples – relative productivity higher than 2.5, thus France has comparative advantage
- What happens if there are 5 countries?
  - In theory, a country can claim a comparative advantage for at least one good
  - Applies to all jobs and labor force
  - What if there are more countries than goods?

Extension 3. Many goods + Transportation
- When theory meets limit in real world
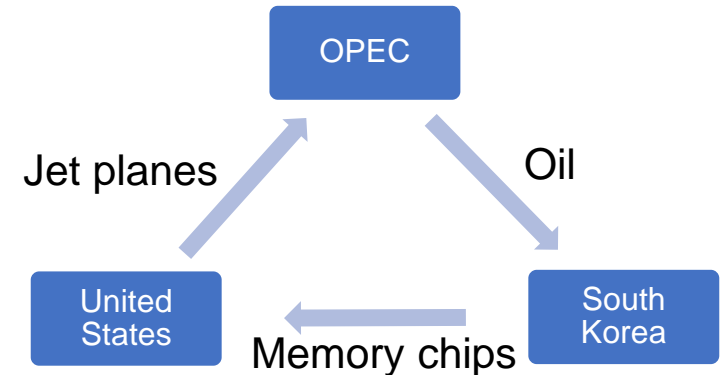
Many goods + Transportation

A case w/ transportation cost

■ Assume price of imported goods are <u>doubled</u> due to transportation cost (or tariff, or whatever the cost for crossing the border, assuming wage unaffected)

Good	L_i (Fr)	L*_i (Ge)	L*_i / L_i	W/W*	CA
Calculator	50	**40**	**0.4 -> 0.8**	2.5	G
Bread	1	**4**	**2 -> 4**	2.5	NT
Cheese	**6**	9	**3 -> 1.5**	2.5	NT
Wine	**10**	20	**4 -> 2**	2.5	NT
Apples	**6**	30	**10 -> 5**	2.5	F

■ Relative productivity of calculator and apples are still smaller or greater than the relative wage, thus comparative advantage still holds for both goods
■ However, all other goods' relative productivity now cannot cross relative wage, yielding trade unprofitable
■ Any friction can cause such inefficiency, although it may protect domestic suppliers from globalized competition

Many goods + multiple sectors + any friction

OPEC

Jet planes   Oil

United States   Memory chips   South Korea

■ In theory, if there are n goods w/ n countries, all have at least 1 comparative advantage, but given a friction, the cross-border trade (i.e. international cooperation) occurs less than what can be expected in the model
■ The same logic applies to HR's team assignments, outsourcing, a company's new business plan, and even to choice of a college major for every individual
■ If you don't like the terms of trade (or wage, team assignment, etc), but if your cost of altering productivity is way too much, then give a second thought before investment. Why not try sth else?
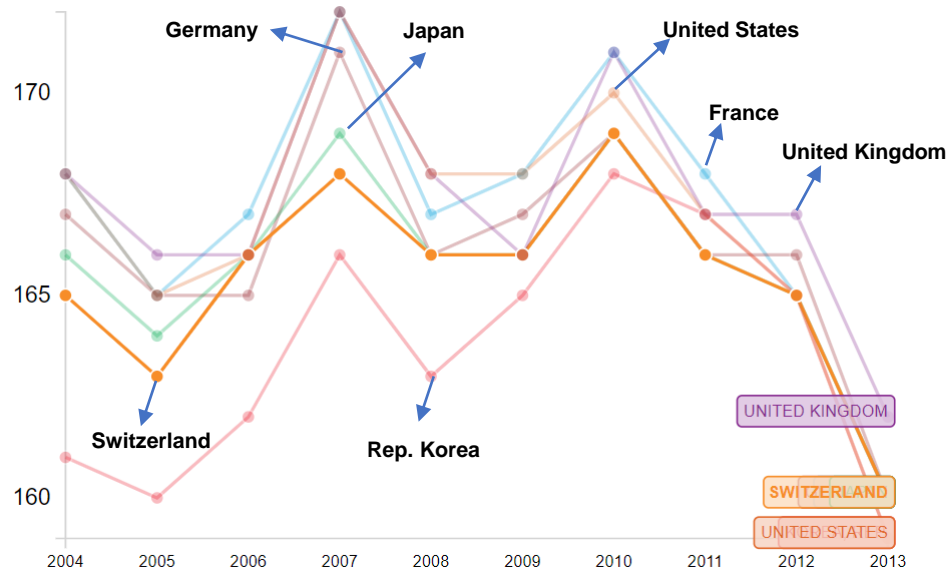
Extension 4. Revealed comparative advantage
- Real world (w/ many goods and many countries) cases can be explained by CA

<table><tr><td>**"Revealed" comparative advantage**</td><td>**Formulae for RCA**</td></tr></table>

"Revealed" comparative advantage

Definition

■ The revealed comparative advantage of a nation is measured by the relative weight of a percentage of total export of commodity's in a nation over the percentage of world export in that commodity

Source: https://tcdata360.worldbank.org/indicators/h62a3e8cc

Usually a sign of country's competitiveness!

Formulae for RCA

Revealed comparative advantage (Balassa index)

$$RCA_{kj} = \frac{X_k^j / \sum_k X_k^j}{\sum_k X_k^j / \sum_k \sum_j X_k^j}$$

■ k is an industrial index while j is a country index, X is export

■ When RCA >1, country j has a revealed comparative advantage on commodity k

■ When RCA <1, country j has a revealed comparative disadvantage on commodity k

Intra-Industry Trade Index

$$I = 1 - \left| \frac{\text{Export} - \text{Import}}{\text{Export} + \text{Import}} \right|$$

■ Formula to calculate the importance of intra-industry trade within a given industry (in a country)

■ If a country only exports/imports in that industry, I = 0

■ If a country's exports and imports within an industry are equal, then I = 1

Revealed comparative advantage examples
- A proxy for a country's industry specific competitiveness

A country's "revealed" comparative advantage in time series										
Service-Category	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Goods-related services, manufacturing services	8.99	8.55	10.52	5.91	5.27	5.11	5.68	5.96	5.76	5.70
Maintenance and repair services	3.31	3.84	2.48	1.31	1.08	1.48	1.60	1.83	1.72	1.75
Transport	1.42	1.59	1.56	1.71	1.69	1.73	1.79	1.80	1.89	1.96
Travel, business	0.65	0.89	0.97	0.87	1.17	1.42	1.57	1.90	2.07	2.27
Construction	1.86	2.29	1.96	2.04	2.16	1.46	3.40	4.16	4.42	3.11
Insurance and pension services	0.41	0.57	0.39	0.47	0.30	0.57	0.57	0.68	0.56	0.55
Financial services	0.41	0.39	0.44	0.62	0.67	0.69	0.70	0.97	0.95	1.09
Charges for the use of intellectual property	0.10	0.11	0.10	0.12	0.12	0.17	0.17	0.18	0.17	0.18
Telecommunications, computer, and information services	0.91	1.08	1.16	1.20	1.41	1.59	1.70	1.75	1.83	2.07
Other business services	1.31	1.21	1.25	1.18	1.22	1.24	1.27	1.36	1.42	1.53
Research and development (R&D)	3.62	3.81	3.56	2.91	3.45	3.81	3.40	4.71	5.31	6.40
Professional and management consulting services	1.43	1.27	1.29	1.10	1.10	1.12	1.19	1.27	1.36	1.49
Personal, cultural, and recreational services	0.33	0.33	0.34	0.50	0.53	0.63	0.89	0.92	1.38	1.54
Government services	0.13	0.07	0.01	0.01	0.02	0.01	0.01	0.00	0.99	0.04
Commercial services	1.15	1.22	1.24	1.30	1.33	1.37	1.46	1.53	1.58	1.65
Technical, trade-related, and other business services	1.17	1.06	1.12	1.16	1.19	1.19	1.19	1.24	1.25	1.29

Source: UNCTAD, Handbook of Statistics 2020

Source: https://unctadstat.unctad.org/en/RcaRadar.html

Revealed comparative advantage examples (cont'd)

- A proxy for a country's industry specific competitiveness

Two countries' "revealed" comparative advantage in 2019

Poland

Switzerland

Source: https://unctadstat.unctad.org/en/RcaRadar.html