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Environmental and Health Economics
ECON/ENVR/SOSC 2310

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Harvesting Game

- Form groups (6-7 per persons group)
  - Choose a representative of your group, who is responsible to harvest fish for the entire family
- Initially, we have a stock of fish in the lake
- Each round, a fisherman can harvest up to 5 fish
  - Each fisherman can only harvest once in a specific round
- After the 1st round, for every 2 fish that was left in the lake, the fish population will increase by 1 (natural growth)
- Next round, fishermen keep harvesting fish…

The Tragedy of Commons

- The Tragedy of the Commons is a parable that illustrates why common resources get used more than is desirable from the standpoint of society as a whole.

- When one person uses a common resource, he or she diminishes another person's enjoyment of it.

- Common resources tend to be used excessively when individuals are not charged for their usage.

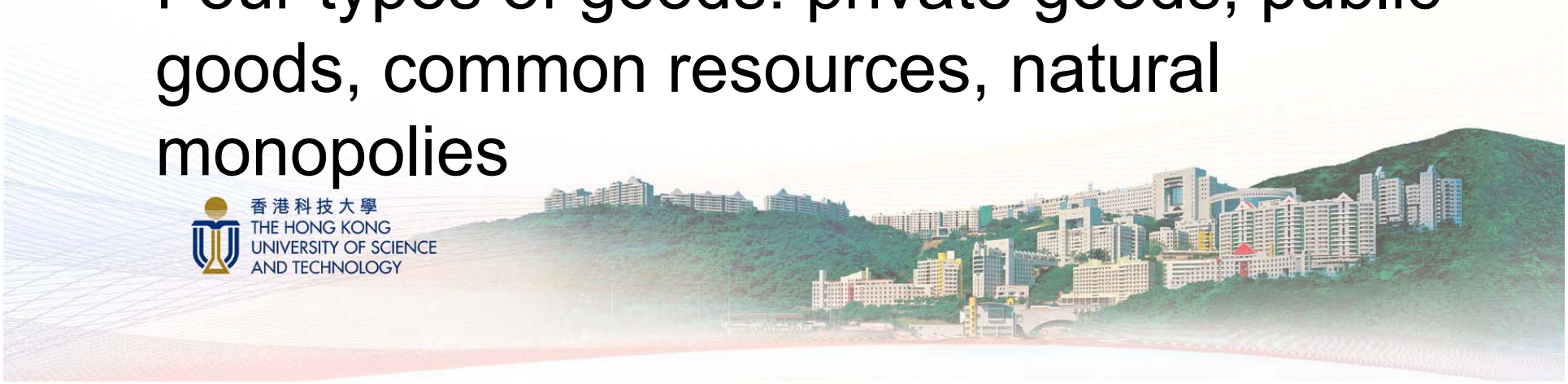
- This creates a negative externality.

Public Goods and Common Resources

- Most goods in our economy are allocated in markets
- Prices are the signals that guide the decision of buyers and sellers
- Free goods provide a special challenge for economic analysis
- Many environmental goods are free and not traded on the market

Different Kinds of Goods

- Excludability: People can be prevented from enjoying the good
- Rivalness: One person's use of the good diminishes another person's enjoyment of it.
- Four types of goods: private goods; public goods, common resources, natural monopolies

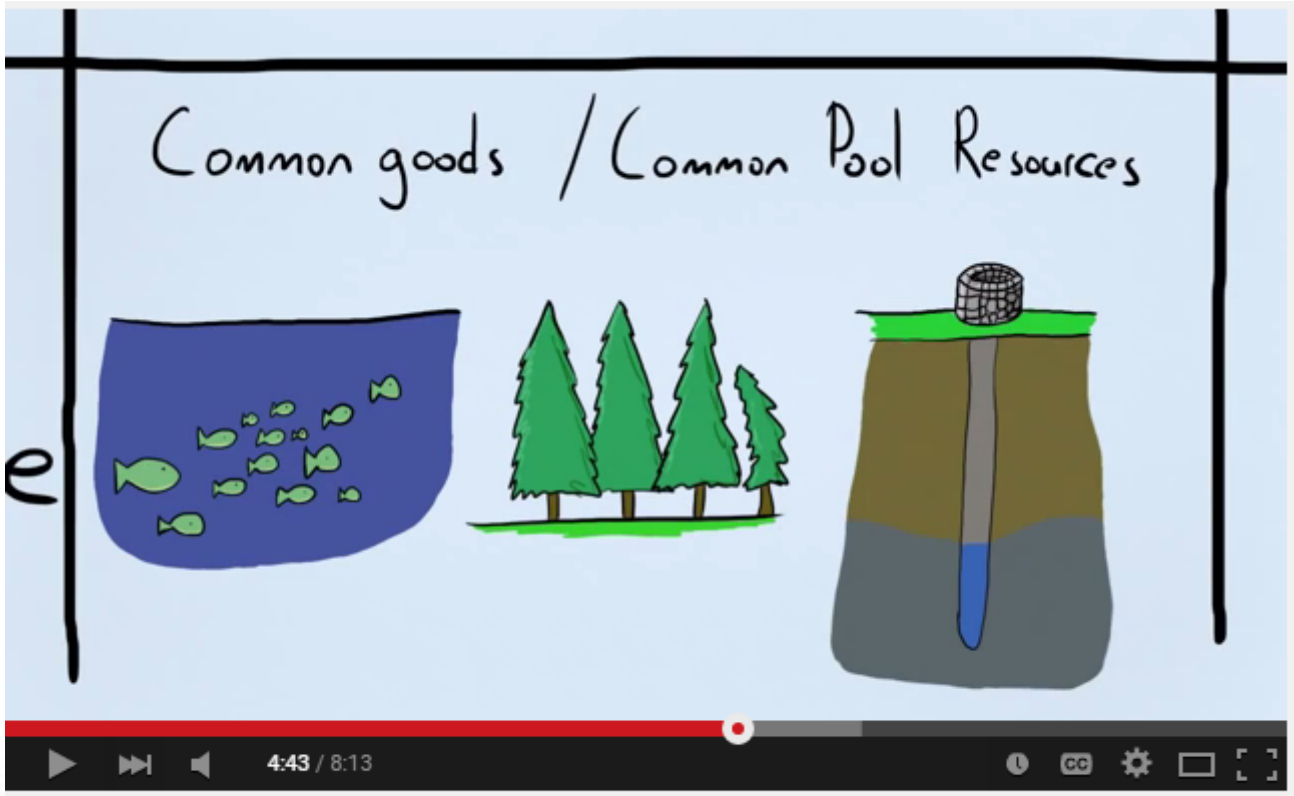


Types of Goods

- Private Goods: excludable and rival
- Public Goods: non-excludable and non-rival: national defense
- Common Resources: Rival but not excludable: fish in the ocean
- Natural Monopolies: Excludable not rival: fire protection, cable TV

Public Goods vs Private Goods

https://www.youtube.com/watch?v=E1v5eRs0_fw



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Common Resources

- Common resources are rival goods because one person's use of the common resource reduces other people's use.
- Clean air and water\Oil pools\ Fish, whales and other wildlife

Examples of Common Resources

- Clean air and water
- Oil pools
- Fish, whales and other wildlife

http://www.sabistyle.com.au/blog/?m=201010

http://www.indiweb.in/career/career-in-fishery-science/

http://www.visualphotos.com/image/2x3787610/sheep_grazing_in_a_pasture_derbyshire_england

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Elephant

- Elephants are magnificent animals.
- Largest mammals on land

Tusk:

- Social displays of dominance
- Defending against attackers
- Digging and boring tools

Ivory Products

Poachers

Poachers killed one of the world's largest elephants – Satao

News

African elephants are being born without tusks due to poaching, researchers say

The species could become extinct in some areas, with those elephants that do survive evolving to be almost completely tuskless

- An increasing number of African elephants are now born tuskless because poachers have consistently targeted animals with the best ivory over decades, fundamentally altering the gene pool.
- In some areas 98 percent of female elephants now have no tusks, researchers have said, compared to between two and six per cent born tuskless on average in the past.
- Among elephants that remained tusked, the tusks were smaller than in elephants' a century before – roughly half their previous size

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Ivory Industry

- The Plight of the Elephant | Battle for the Elephants
  - Episode 1: https://youtu.be/PNjb9uvurTU
  - Episode 2: https://youtu.be/7Oo6SCt4erI
  - Episode 3: https://youtu.be/ws6X9FIvL0s
  - Episode 4: https://youtu.be/a9cZvhzoq7A

The Elephant

- The Convention on International Trade in Endangered Species (CITES) secured an agreement in 1989 among its member states to ban the international trade in ivory.

- On December 30, 2016, China announce it will shut down the trade of ivory within its borders by the end of 2017.

- However, there is a debate on whether it will be an effective way to do it.

The Elephant

- Elephants population continued to decrease after CITES.
- Some argue that a legal ivory trade will actually reduce poaching and protect elephants.
- Why?

Solutions to Common Resource Problems

- Quantity control
- Taxation
- Permit
- Property rights

Importance of Property Rights

- The market fails to allocate resources efficiently when property rights are not well-established (i.e. some item of value does not have an owner with the legal authority to control it).

- One way to solve this problem is to assign the property to the private parties.

Why aren’t the cows and pigs extinct?

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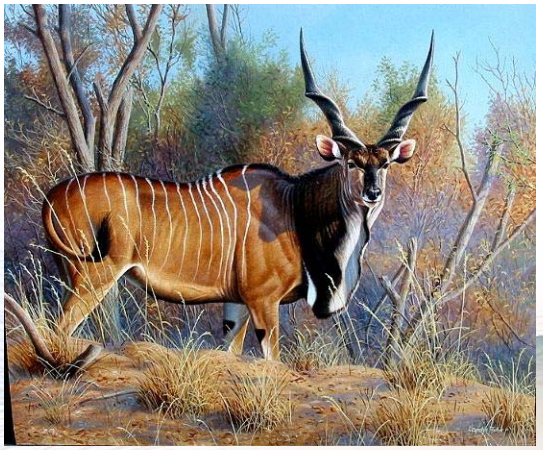
Elephant in Zimbabwe

- The number of elephants in Kenya dropped from 65,000 to 19,000 between 1979 and 1989.
- The number of elephants in Zimbabwe increased from 30,000 to 43,000 where elephants were legally sold and private ownership of elephants were allowed, and the private owners of the elephants provided all the security to the wildlife to prevent poaching.
- Further Reading:
  - http://youtu.be/QouamYWL6vc
  - http://www.icer.it/docs/wp2000/Nelson22000.pdf

- “Privatization of control over use of wildlife has had more success in promoting biodiversity in the southern African region than any other policy measure.”

- In Zimbabwe, 94 percent of eland, 64 percent of kudu, 63 percent of giraffe, 56 percent of cheetah, and 53 percent of both sable and impala — are found on commercial ranch properties.



Common Resources

- However, sometimes the transaction costs can so high that the private solution will not always work. Also, people tend to only protect those they like.

- When the absence of property rights causes a market failure, the government can potentially solve the problem.

Public Goods

- Public goods are goods that can benefit everyone, and from which no one can be excluded.

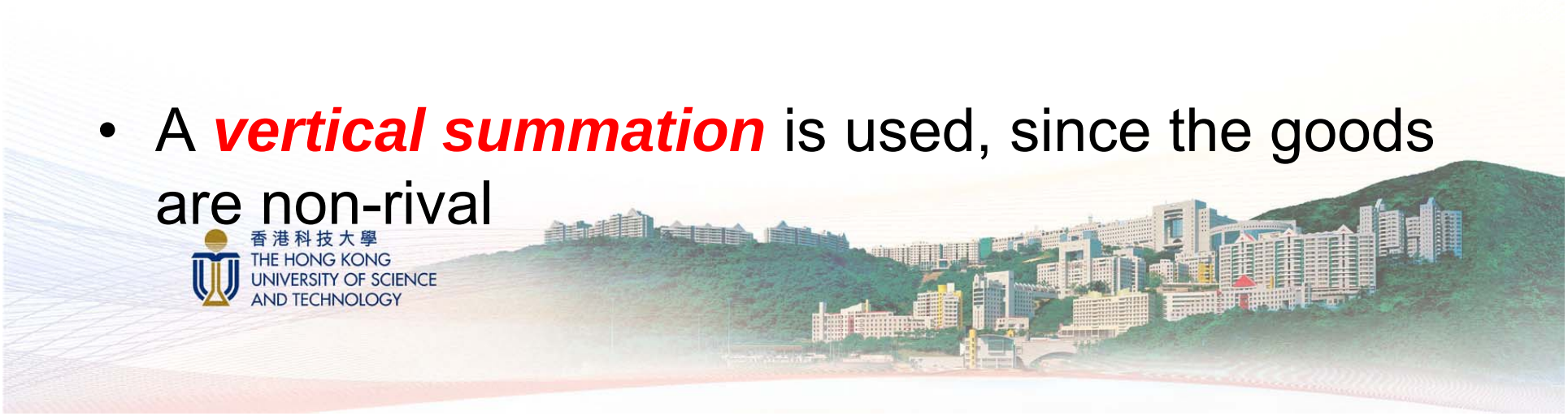
- Thus, it is difficult to collect money for the good.

Efficient Allocation of a Public Good

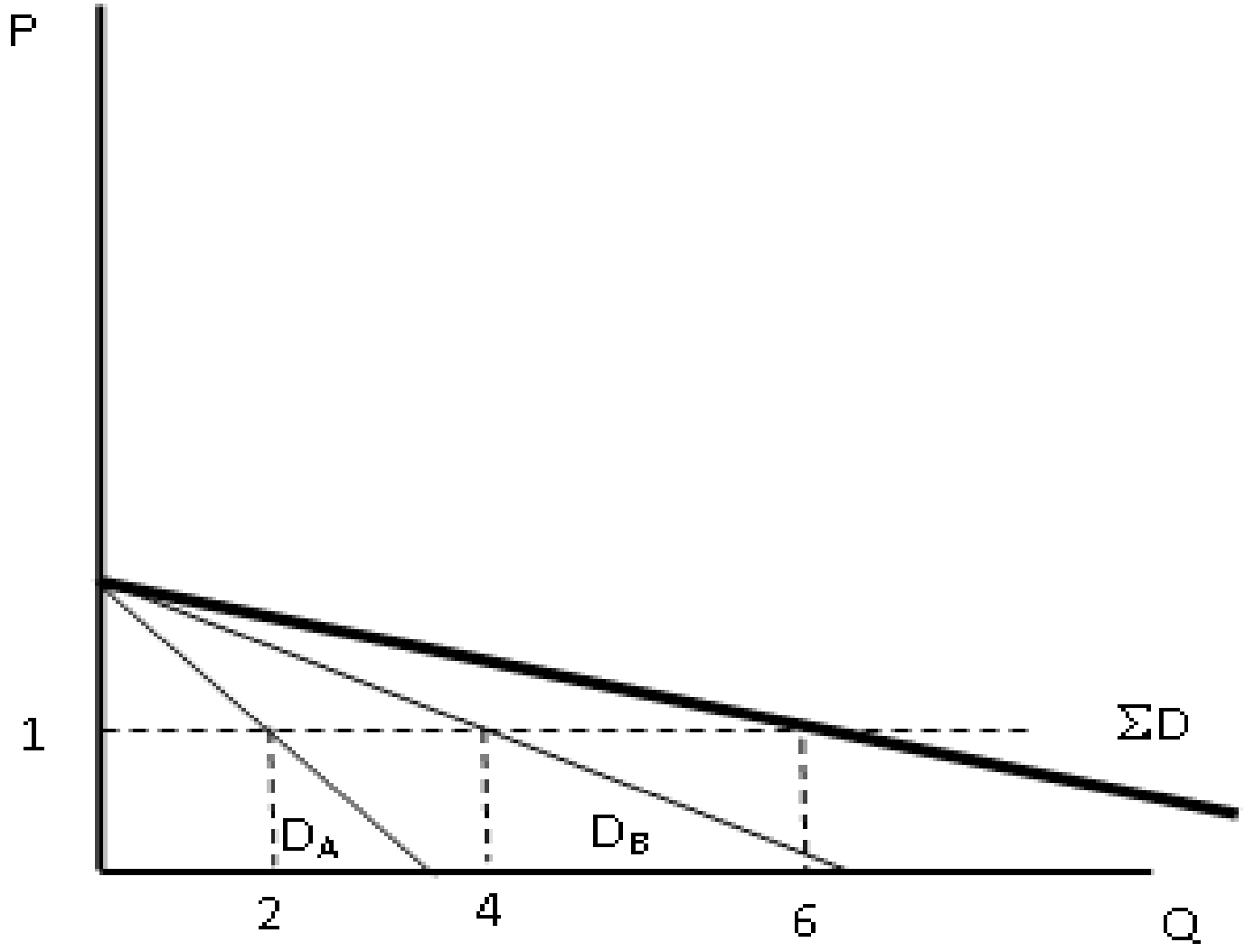
- The demand for a private good is different from that for a public good.

- Because public goods can be enjoyed by everyone, we need the summation of each individual's marginal benefit.

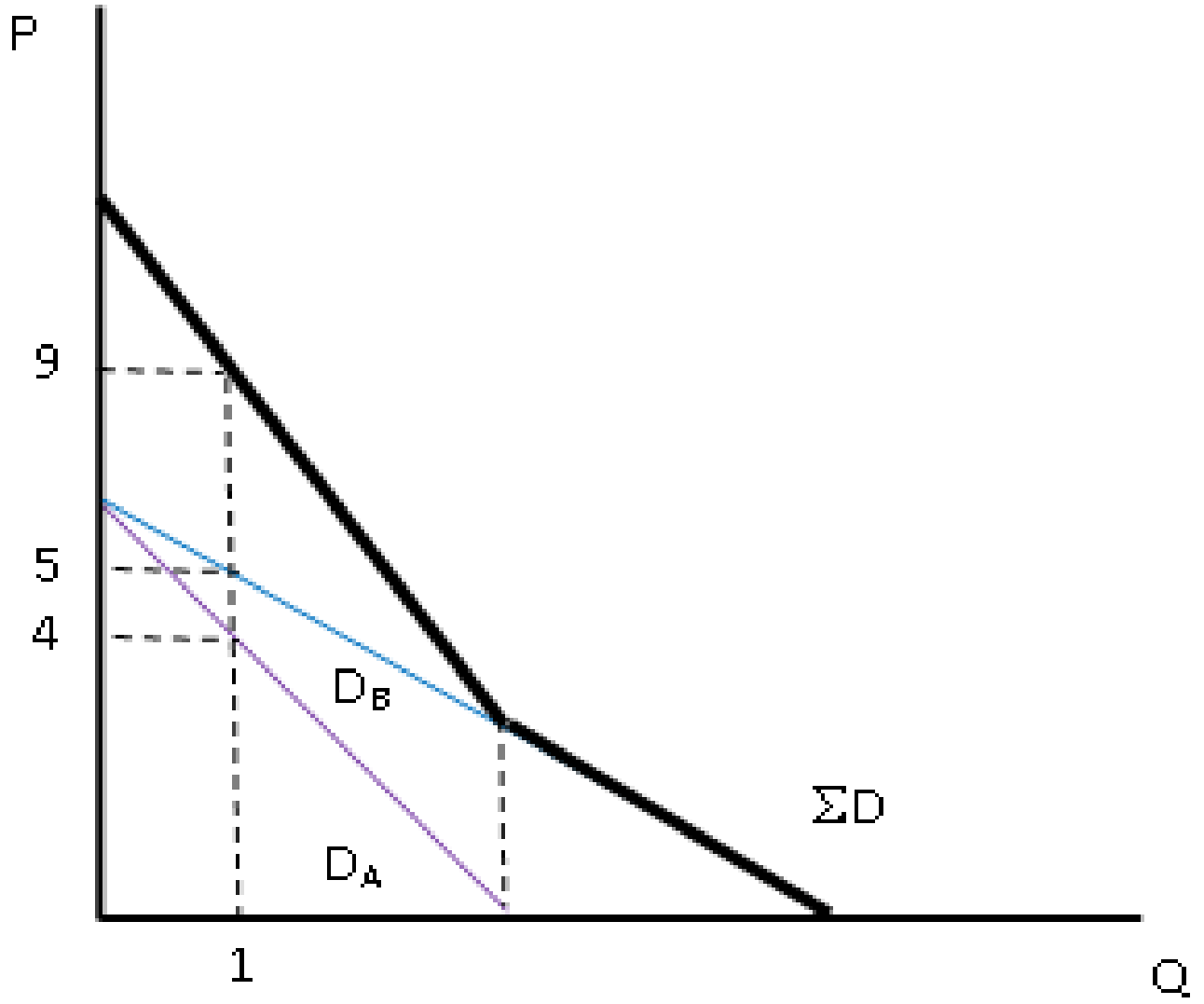
- A ***vertical summation*** is used, since the goods are non-rival



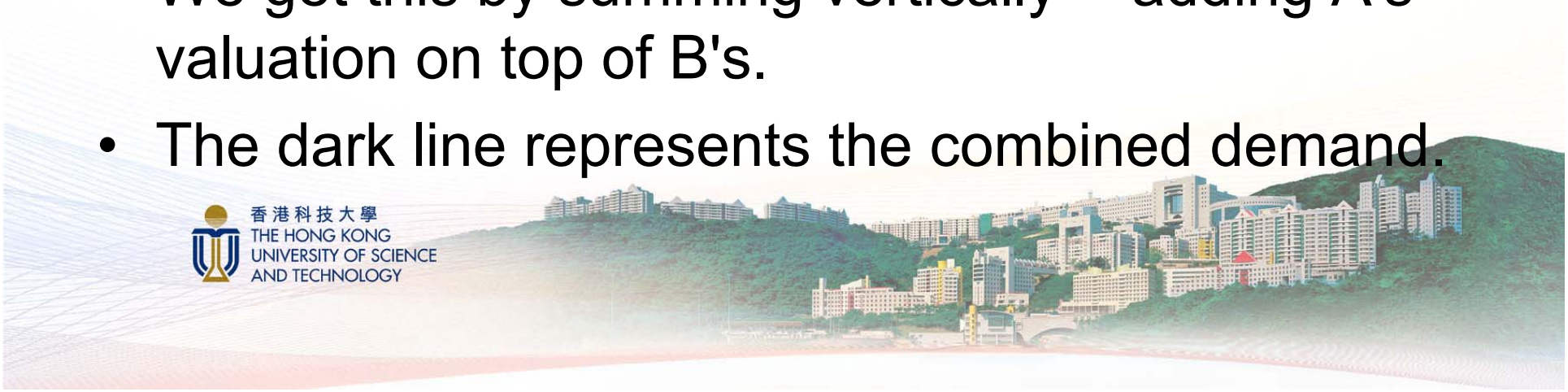
Horizontal Summation of Private Goods



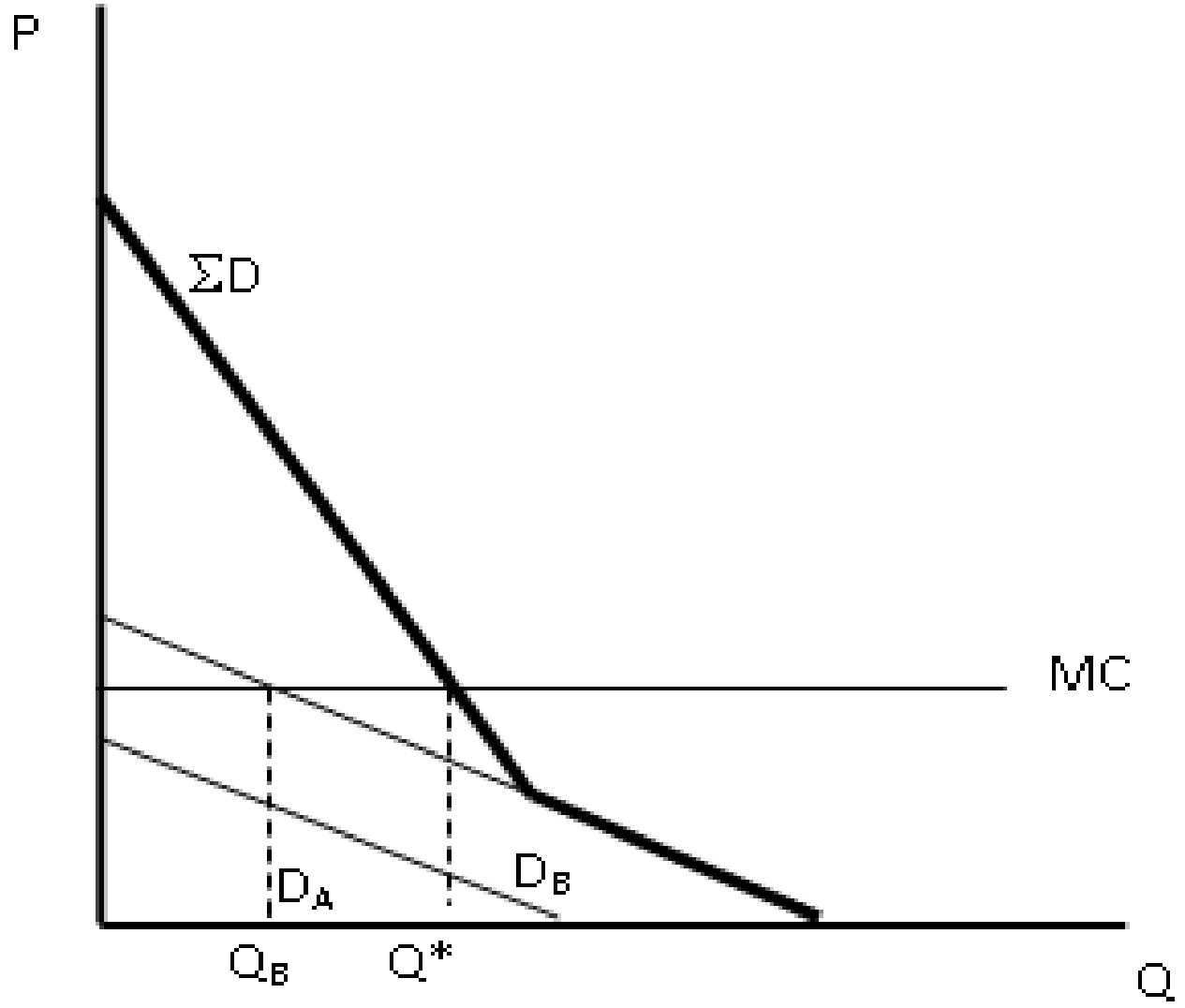
Vertical Summation



- D_A (purple line) represents the demand curve for person A, and D_B (blue line) is the demand curve for person B.
- One unit of the public good is worth $4 to person A, and $5 to person B.
- Since both can enjoy the good at the same time, the total marginal benefit of one unit of the good is $9.
- We get this by summing vertically -- adding A's valuation on top of B's.
- The dark line represents the combined demand.



Private Provision of Public Goods

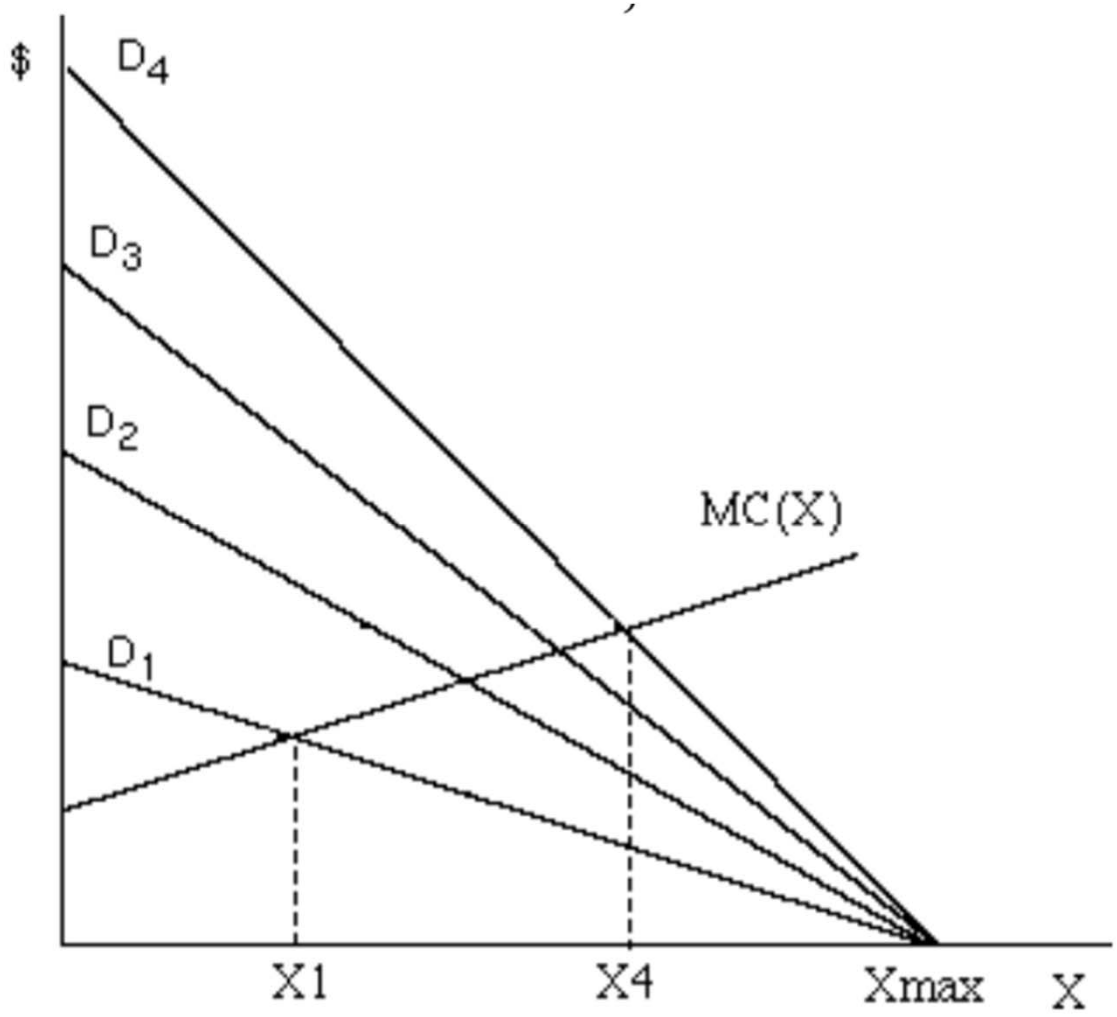


Under-Provision of Public Goods in Private Market

- Since each individual is concerned with his or her own marginal benefit, under-provision results.

- This results from the non-rival nature of a public good. When deciding how much of a public good to purchase, each person considers their own benefits. However, they do not consider that their purchase also benefits others.

More individuals



More individuals

- The socially-optimal level of public good X with four consumers is X4.

- What is the optimal level of the public good with a very large number of individuals?

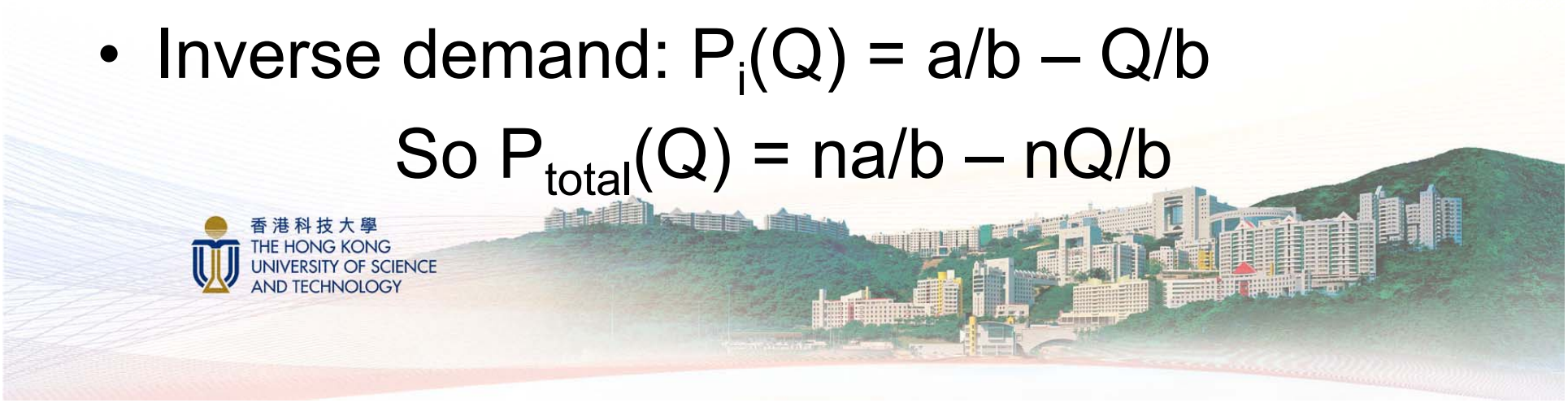
Math Representation

- Q: quantity of good
- Demand of one individual i: $Q_i = a – bP$
- Horizontal summation (private goods):

$$Q_{total} = nQ_i = na\text{-}nbp$$

- Vertical summation (public goods):
- Inverse demand: $P_i(Q) = a/b – Q/b$

$$\text{So } P_{total}(Q) = na/b – nQ/b$$



The Free-rider Problem

- A free-rider is a person who receives the benefit of a good but avoids paying for it.
- Since people cannot be excluded from enjoying the benefits of a public good, individuals may withhold paying for the good hoping that others will pay for it.
- The free-rider problem prevents private markets from supplying public goods.

What can be done about the free rider problem?

- Compulsory provision – the government can collect taxes from everyone to make them pay a share of the cost.
- Social pressure – pressure people into contributing "voluntarily."
- Mergers – if individuals combine into a single entity, the free rider problem is no longer relevant.
- Privatization – if exclusion is possible, the free rider problem no longer exists.

What can be done about the free rider problem?

- In history, many public goods are financed by the rich:
  - Music and the Arts were financed by kings and knights.
  - The rich educated themselves: collected books and preserved knowledge.
  - The rich can buy expensive early versions of new products, hence generating incentives for R&D oriented towards innovation due to larger monetary incentives.

Political Economy of Public Goods Provision

- Finding everyone's true valuation can be difficult.
- Governments often use the results of votes to determine how much value the public places on a public good.
- The Majority Rule
  - A voter will vote yes for a project if their valuation is greater than their share of the payment (e.g. their tax payment)
  - The proposal with more votes will be approved

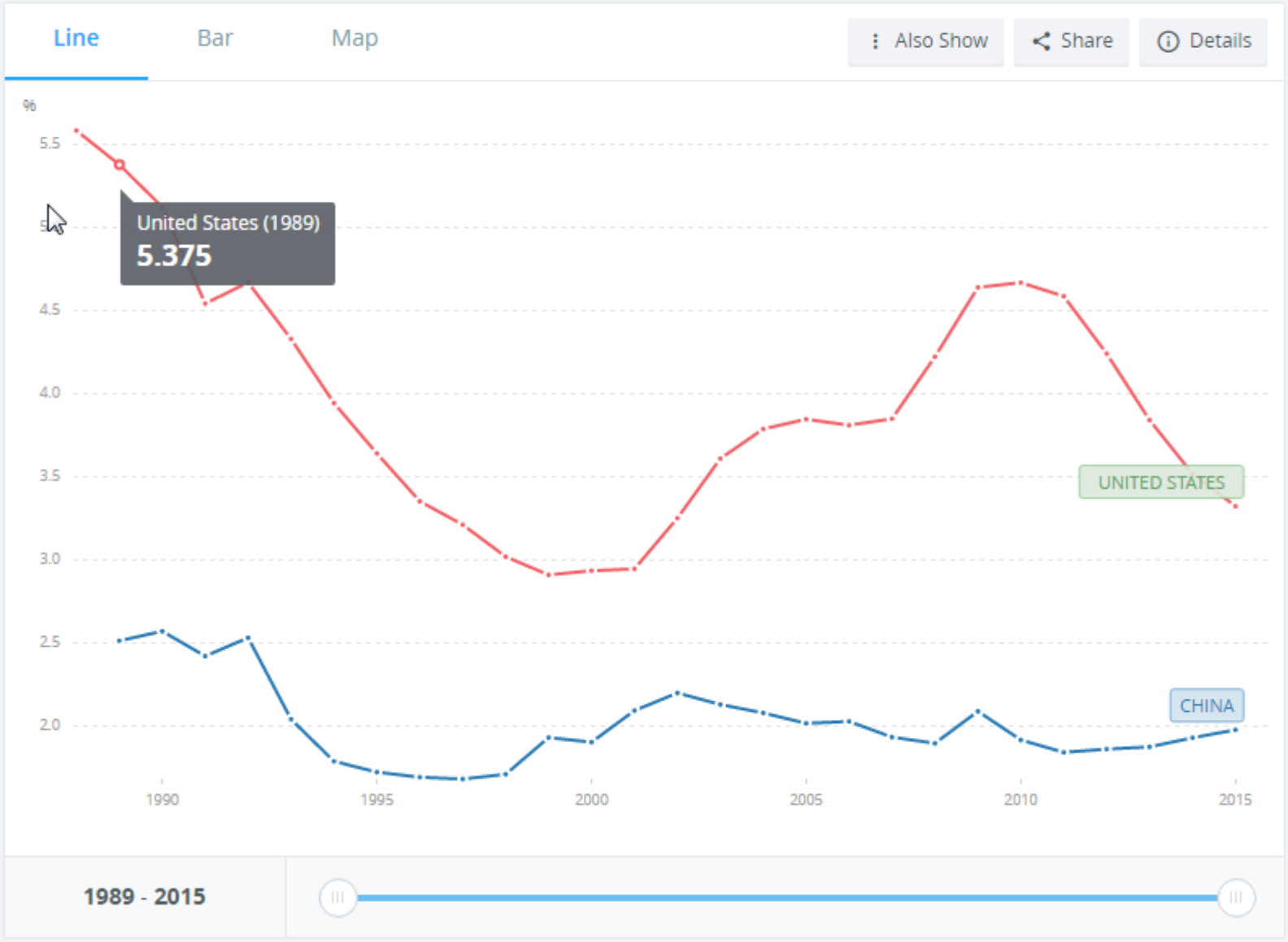
Voting and Public Goods

- Consider a one-dimensional case: how much national defense should the government supply?

Military expenditure (% of GDP)

Stockholm International Peace Research Institute (SIPRI), Yearbook: Armaments, Disarmament and International Security.

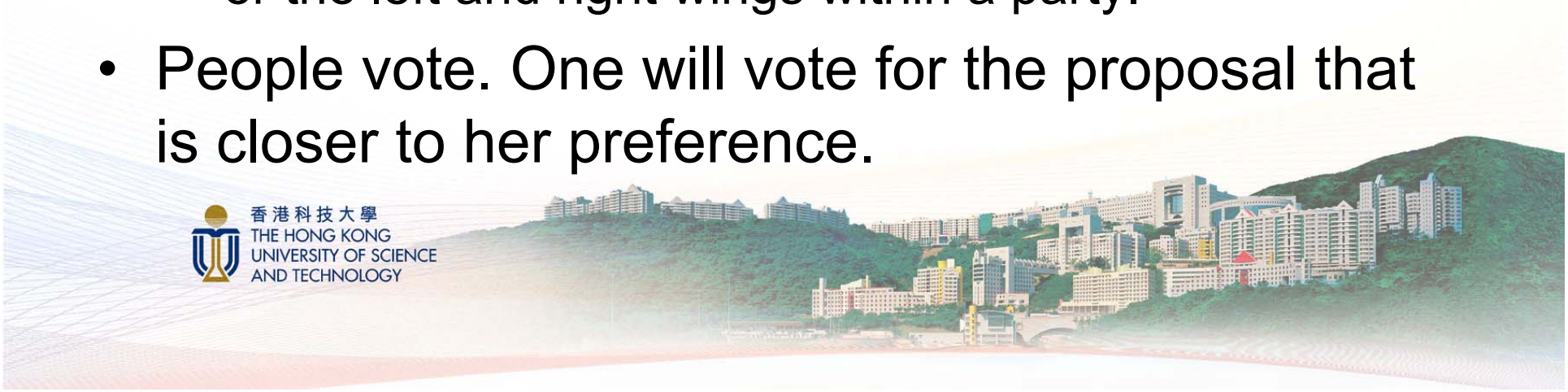
License: Open

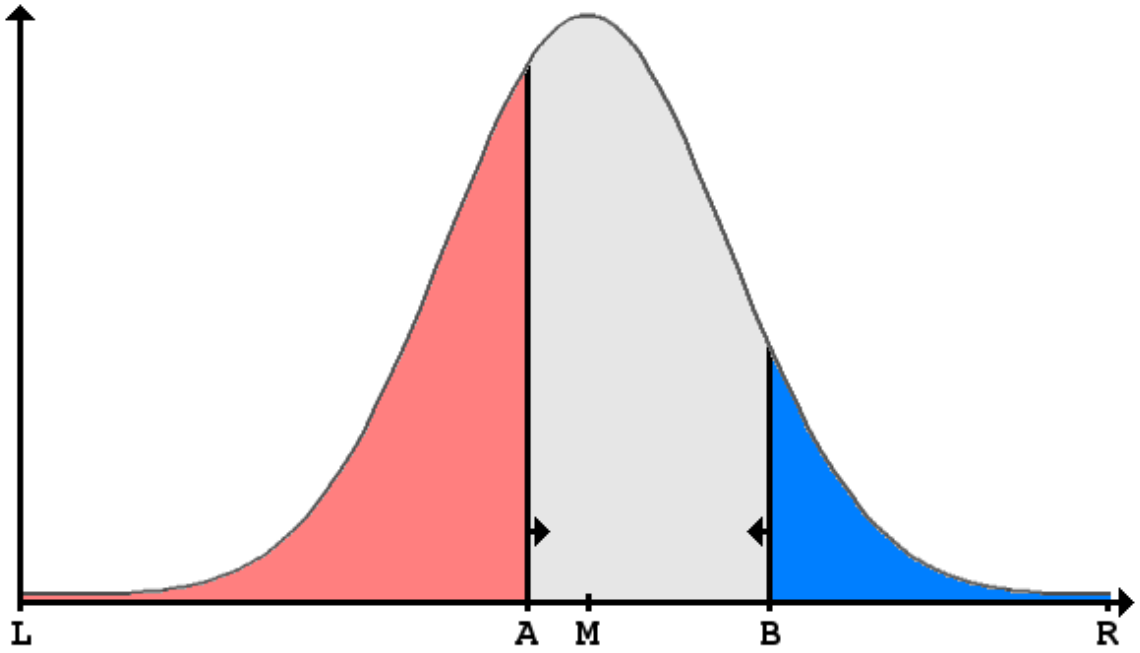


Source: World Bank

Example

- People have their own preferences regarding to how much national defense is desired: suppose from 0% to 10% GDP.
- There are two proposals about how much national defense needs to be provided:
  - May come from the two parties in the political system, or the left and right wings within a party.
- People vote. One will vote for the proposal that is closer to her preference.





The **median voter** is the person for whom half of society has a higher valuation, and half has a lower valuation.

Distortions of Incentives for the Politicians

- Adam Smith: People are self-interested, so do politicians (desire for power, income, and prestige…)

- To win the majority, politicians have an incentive to make their policies closer to the median voter's preferences, instead of achieving economic efficiency (maximizing social welfare)

- For example, in the United States, the Democratic and Republican candidates typically move their campaign platforms towards the middle during congressional election campaigns.

- Just as sellers in a free market try to win over their competitors' customers by making slight changes to improve their products, so too do politicians deviate only slightly from their opponent's platform so as to gain votes.

Voting and Public Goods

- The **median voter theorem** states that a "majority rule" voting system will select the outcome most preferred by the median voter.

- In this case, the median voter's preference will determine the level of national defense.

Potential Problems

- This probably does not calculate the full value of a public good, and thus does not guarantee that an efficient outcome will occur

- Another problem is that intensity of preferences is ignored

More on Political Economy*

- God comes to the Soviet people and says: 'I will give each of you a choice of three blessings in life, but you can only have two out of the three. You can be an honest person, you can be a smart person, or you can be a member of the Communist Party. If you are smart and honest, then you cannot be a communist. If you are a smart communist, then you cannot be honest. And if you are an honest communist, then obviously, you must not be very smart.'

Soviet era joke

More on Political Economy*

- When voters have three or more distinct alternatives (options), what would happen?
- Let's play another game:
  - Consider a company board of directors who must decide policy. They can commit themselves to being an Honest company, a Profitable company or a company that relies on Government contracts.
  - Imagine a Left–Centre–Right split among the directors.

- Three Important goals for the company are:
  - Honesty (H)
  - Profitability (P)
  - Government Contracts (G)

- Board of Directors' Preferences:
  - Left (L): G > H > P
  - Centre (C): P > G > H
  - Right (R): H > P > G
  - where '>' means 'preferred to'

- The Left prefers government work for an honest company – one that cannot be profitable.
- The Centre prefers a profitable company with government work – one that cannot be honest.
- The Right prefers an honest and profitable company – with no government work.

Game: Now we do a pair-wise voting

- First round, directors vote on two alternatives, say Honesty (H) vs Profitability (P).

- Second round, they will vote between Government Contracts (G) and the winning Option in the first round (H or P).

- Which option will win? Who is happy?

Now suppose

- Suppose you can set the agenda on the order of voting.

- What will you your strategy?

- If Left (L) is setting the agenda, it ensures its first-best outcome by setting the order of the two pair-wise contests: first H (honest) versus P (profitable), and then G (government contracts) versus H (honest).

- Similarly, each of the other two blocs can achieve its own best result by agenda setting to ensure that its own favorite option is included in the last pair-wise contest.

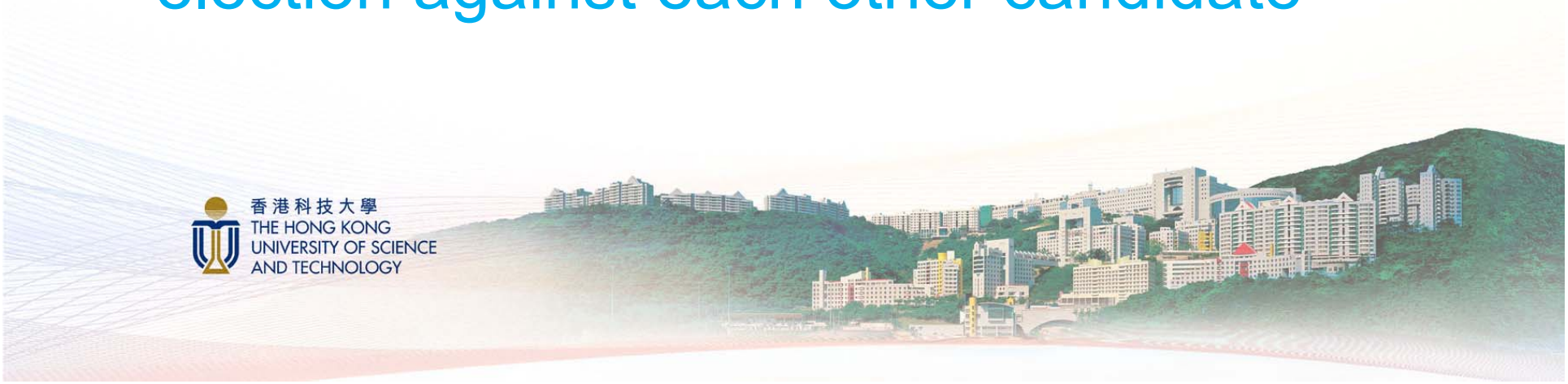
Voting paradox (Condorcet's paradox)

- Collective preferences can be cyclic (i.e., not transitive), even if the preferences of individual voters are not cyclic.
- This is paradoxical, because it means that majority wishes can be in conflict with each other.

Voting paradox (Condorcet's paradox)

- When this occurs, it is because the conflicting majorities are each made up of different groups of individuals.

- No candidate who can win a one-on-one election against each other candidate



Implications

- Suppose the winner of H versus P in the open primary contest for one party's leadership will then face the second party's leader, G, in the general election.
- H would defeat P for the first party's nomination, and then would lose to G in the general election.
- But if P were in the second party instead of the first, he would defeat G for that party's nomination, and then would lose to H in the general election.

Implications

- Similarly, the structure of a sequence of votes in a legislature can be manipulated by the person arranging the votes, to ensure his preferred outcome.

More on Political Economy*

- Arrow's Impossibility Theorem: when voters have three or more distinct alternatives (options), no voting system can convert the ranked preferences of individuals into a community-wide (complete and transitive) ranking (while also meeting a pre-specified set of "fairness" criteria).

Further Readings

- More complicated game: not truth telling, strategic voting.

- More Reading: https://www.economicsnetwork.ac.uk/iree/v4n2/stodder.htm#holt1999