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Introductory Microeconomics ECO/4002Y

Public Goods

Outline

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- Topics
  - Public Goods -- examples and classifications
  - Why do markets fail
  - Free rider example
  - The Tragedy of the Commons

Public Goods

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- Are goods with benefits that cannot be withheld from those who do not pay and are shared by large groups of consumers
- Are *nonrival* in consumption, meaning that a given quantity of a public good can be enjoyed by more than one consumer without decreasing the amounts enjoyed by rival consumers
- Are *nonexclusive*, meaning it is too costly to exclude those who refuse to pay from enjoying the benefits
- Usually made available politically through voting on how much to supply

Public good: a special type of good

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- Markets deal badly with some goods

- Consider some examples:
  - Street light
  - A motorway
  - A tennis court in a public park
  - A private health club

- All are public goods, in the sense that they are shared by the users (with a common interest)

- There are many other public goods (defence, collective actions, national health insurance, a collective course work), and some differences

Street light: A pure public good

- Citizens can share it without reducing each other's consumption (**Non-rivalry** in consumption)
- One's use of street light does not exclude another person's use of street light (**Non-excludability** in consumption)
- A good is a public good if it is non-rival and non-excludable (lighthouse, police force, charity)
- A private good is not non-rival and it excludes others from consumption (ice-cream)

Classifying Goods And Resources

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- **Excludable**: A good, service, or resource is excludable if it is possible to prevent a person from enjoying its benefits.

- **Nonexcludable**: A good, service, or resource is nonexcludable if it is impossible to prevent a person from enjoying its benefits.

- **Rival**: A good, service, or resource is rival if its consumption by one person decreases its consumption by other people.

- **Nonrival**: A good, service, or resource is nonrival if its consumption by one person does not decrease its consumption by other people.

Classifying Goods And Resources

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- Excludable
  - The services of Brinks security
  - Fish in a fish farm
  - A live concert
- Nonexcludable
  - The services of the city police department
  - Fish in the Atlantic Ocean
  - A broadcast television signal
- Rival
  - The services of Brinks security
  - Fish both in ocean and in a fish farm
  - A seat at a live concert
- Nonrival
  - The protection provided by a city police department
  - A broadcast television signal

Impure Public Goods

- Motorway: Non-rival but sometimes excludable (congestion, fees)
- Tennis court in a public park: rival, non-excludable
- Club-goods (UEA Sportspark, War veterans association, Blue badge holders, Oxford alumni association): excludable to outsiders, but public good to the club members

Congestible Public Goods

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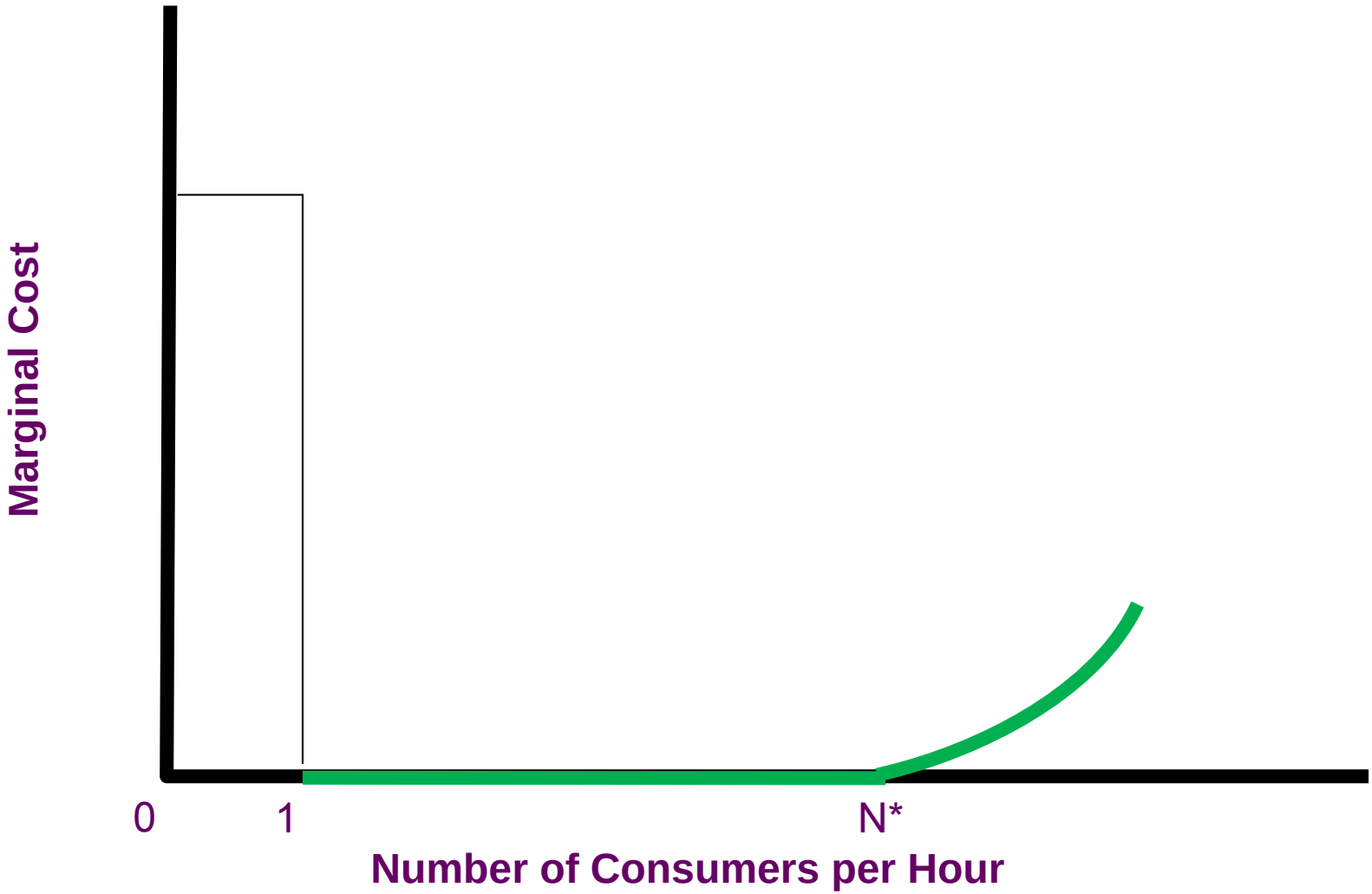
- Goods for which crowding or congestion reduces the benefits to existing consumers when more consumers are accommodated
- Marginal cost of accommodating an additional consumer is not zero after the point of congestion is reached
- E.g., a user of a congested road decreases the benefits to existing users by slowing traffic, increasing accident risk

Congestible Public Goods



Price-excludable Public Goods

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- Goods with benefits that can be priced

- Can be individually consumed and are subject to exclusion, but their production and consumption is likely to generate externalities
  - Non-rival / Congestible and excludable

- Also referred to as "Club Goods"
  - Membership rights to private clubs
  - Schools, hospitals

A Four-Fold Classification

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- Private good – a good or service that can be consumed by only one person at a time and only by those people who have bought it or own it.

- Public good -- a good or service that can be consumed simultaneously by everyone and from which no one can be excluded.

- Common resource -- a resource that is nonexcludable and rival—can be used only once but no one can be prevented from using what is available.

- Club Goods (Natural monopoly) – a good or service that is nonrival but excludable—can be produced at zero marginal cost.

A Four-Fold Classification

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	Excludable	**Non-Excludable**
Rivalrous	Private Goods: food, clothing, cars, personal electronics	Common Resource Goods: fish in ocean, national parks
Non-Rivalrous	Club Goods: cinemas, private parks	Public Goods: free-to-air television, air, national defense

So what?

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- Supply of private goods generally does not need government's active support
  - When firms see a profit opportunity, they can use market mechanisms to organise production and realise profits
- For public goods that does not happen naturally
  - Profit opportunity may or may not exist, and in some cases are not appropriate (care services for disabled, educating children from poor families)
  - PG are a good example of a market failure

Why does market fail?

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- Even when making profit is acceptable there is no natural market mechanism (e.g. prices) by which such profits can be realised and the public good provided

- Provision of public goods requires coordination between users (crucial with congestion or provision points) and collecting subscriptions to finance it

- Given that the consumption of PG is non excludable, paying for it becomes a voluntary action: rational consumers don´t pay, if they don´t need to

- Room for governments, exercising their (pseudo) property right: taxes or user fees

A Public Good Game

A simple example

Demand for a Pure Public Good

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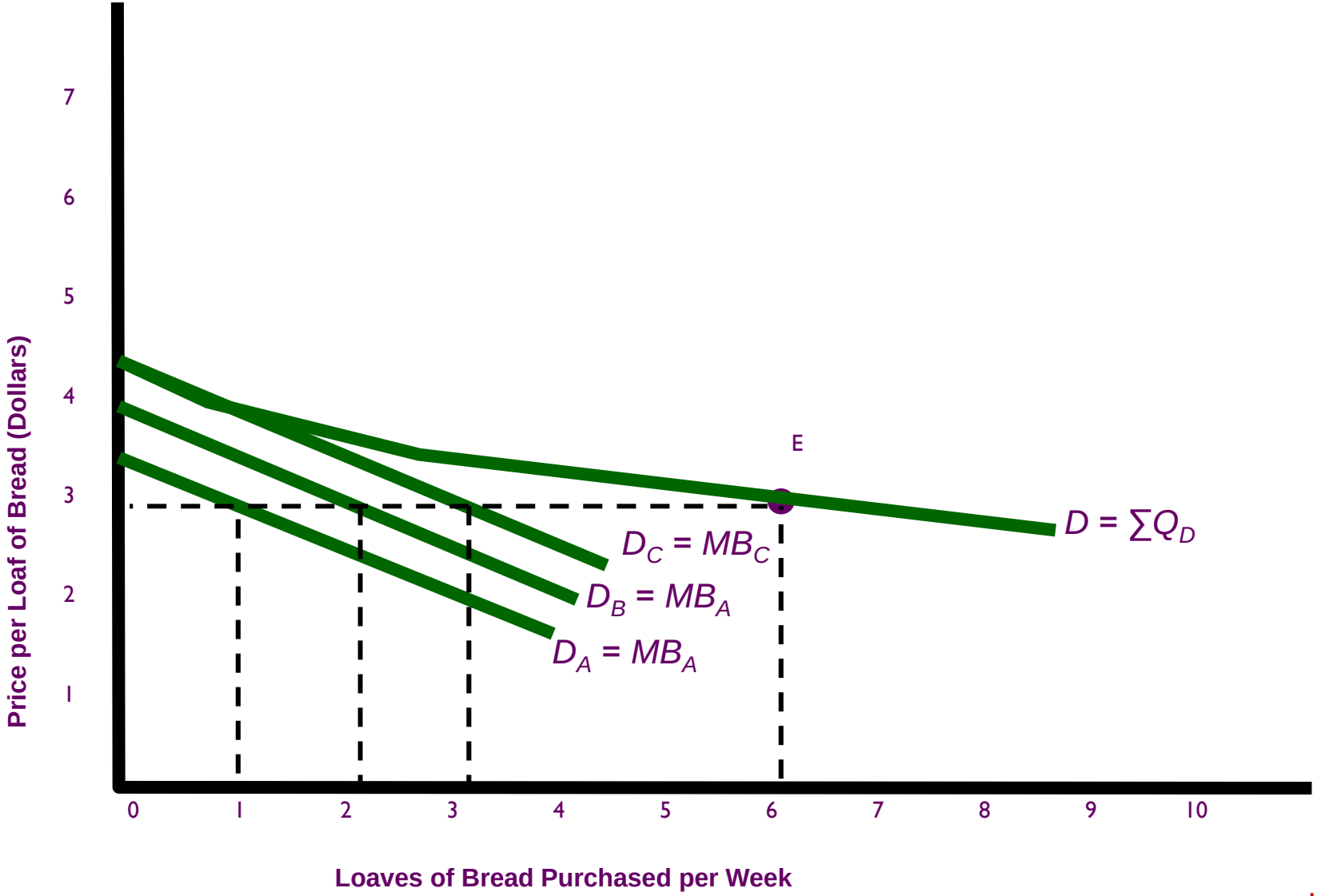
- All consumers must consume the same quantity of the good, as pure public goods cannot be divided into individual units

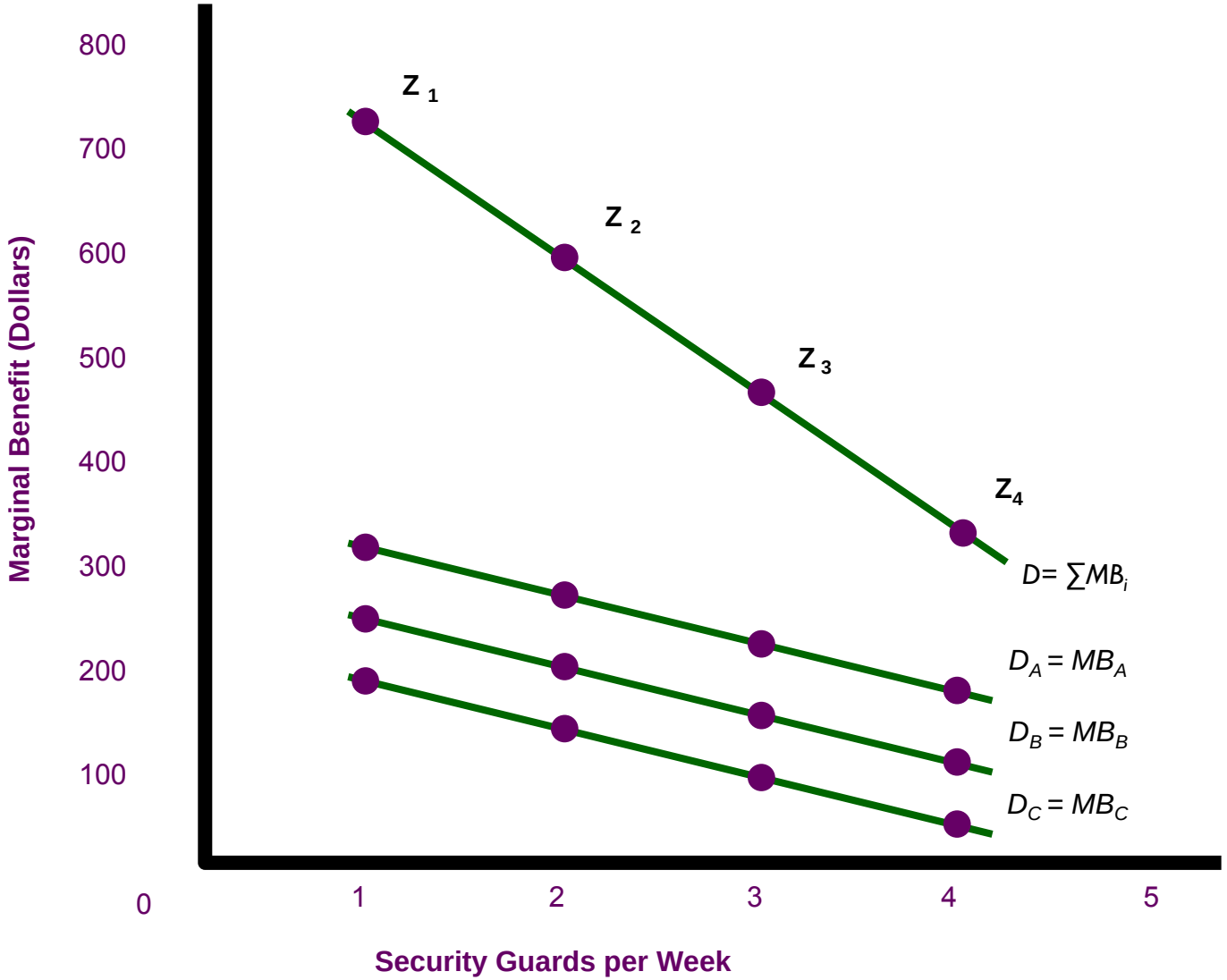
- Therefore, on the demand curve, the variables on the vertical axes are the maximum amounts that people would pay per unit of the pure public good as a function of the amount of the good actually available

- It contrasts with the demand curve for a private good, which is the horizontal sum of the individual demand curves at each price.

Demand for a Pure Private Good



Demand for a Pure Public Good



Efficiency of a Pure Public Good

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- The marginal social benefit of any given amount of a pure public good is the sum of the individual marginal benefits received by all consumers

- Efficient quantity per time period corresponds to the point at which output is increased; sum of marginal benefits to consumers equals marginal social cost of the good

- Efficiency conditions: $MSB = \sum MB = MSC$

Efficiency of a Pure Public Good (example)

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	Number of Security Guards per Week			
	1	2	3	4
MB_A	£300	£250	£200	£150
MB_B	£250	£200	£150	£100
MB_C	£200	£150	£100	£50
∑MB	**£750**	**£600**	**£450**	**£300**

If the cost of security guards is £450 per week, then no individual will hire even one guard, even though to the group one guard is worth £750. The group should hire three ($MSB = \sum MB = MSC$)

If they each pay their marginal benefit, then three guards are hired. Person A pays £600 (£200 per guard), person B pays £450 (£150 per guard) and person C pay £300 (£100 per guard).

Voluntary Contributions and Cost Sharing

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- By sharing costs, members of a community can pool their resources to enjoy public goods that they could not afford if they had to purchase them on their own in a market.
- In small communities, pure public goods could be made available in efficient amounts, financed by voluntary contributions.
- In larger communities, financing by voluntary contributions may not be feasible, because the sum of the marginal benefits of the good would likely fall short of the marginal cost.

The Free-Rider Problem

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- A free rider is a person who seeks to enjoy the benefits of a public good without contributing anything to the cost of financing the amount made available.

- This strategy almost guarantees that the equilibrium amount of a pure public good will be less than the efficient amount.

- Problems become more acute in large groups, where a free rider reasons that their contribution is less likely to be needed or missed.

- Public goods create a free-rider problem because the quantity of the good that a person is able to consume is not influenced by the amount that the person pays for the good, so no one has an incentive to pay and an unregulated market would produce an too little of the good.

Voluntary Contributions and Cost Sharing

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- We all care for "The Public Good" (mentioned in the US declaration of independence): we all care for our community, and we proudly pay for public goods!

- If you ask us to voluntarily contribute to the provision of a public good…

…we would do it!

- Would you?

An example of a Public Good

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- You are endowed with 50 tokens NOW to make a decision
- You may keep the tokens in your pocket
- You may allocate any tokens (0-50) to a group account with other 3 fellow students at random
- The tokens you keep in your pocket are yours
- Tokens in the group account are doubled BY ME and equally shared by all group members (public good)
- The number of tokens you get is your final mark

Our simple example as a game

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	3x0	3x25	3x50
0	50	87.5	125
25	37.5	75	112.5
50	25	62.5	100

Should we care about the *public* good?

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	3x0	3x25	3x50
0	50+50x3	87.5+62.5x3	125+75x3
25	37.5+62.5x3	75+75x3	112.5+87.5x3
50	25+75x3	62.5+87.5x3	**100+100x3**

Should we care about the *public* good?

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	3x0	3x25	3x50
0	200	275	350
25	225	300	375
50	250	325	**400**

Our simple example as a game

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$$\pi_i(x_i, x_{-i}) = (e - x_i) + \frac{B\sum_{i=1}^{n} x_i}{n}$$

$$\pi_i(x_i, x_{-i}) = (e - x_i) + b \cdot \sum_{i=1}^{n} x_i$$

$$1 > b > \frac{1}{n} > 0$$

Our simple example

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$$e = 50 \text{ n} = 4 \text{ b} = \frac{1}{2}$$

	3x0	3x25	3x50
0	50	87.5	125
25	37.5	75	112.5
50	25	62.5	100

The magic words: *What if…*

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	3x0	3x25	3x50
0	50	87.5	125
25	37.5	75	112.5
50	25	62.5	100

The best response is to follow them

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	3x0	3x25	3x50
0	**50**	87.5	125
25	37.5	75	112.5
50	25	62.5	100

What if the other do contribute?

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	3x0	3x25	3x50
0	50	87.5	125
25	37.5	75	112.5
50	25	62.5	100

My best response is NOT to follow

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	3x0	3x25	3x50
0	50	87.5	125
25	37.5	75	112.5
50	25	62.5	100

What if the others are contributing?

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	3x0	3x25	3x50
0	50	87.5	125
25	37.5	75	112.5
50	25	62.5	100

I become a *Free Rider*

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	3x0	3x25	3x50
0	50	87.5	125
25	37.5	75	112.5
50	25	62.5	100

Free riding is a dominant strategy

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	3x0	3x25	3x50
0	50	87.5	125
25	37.5	75	112.5
50	25	62.5	100

A unique inefficient solution

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- Keeping your tokens for yourself is a dominant strategy, and the unique NE (mutual best response) of the game
- This solution is not socially efficient because it would be better for all of you to get 100 rather than 50
- The provision of the PG is socially rational, but the public good is very rarely provided when funded by voluntary contributions (the market)

The provision of public goods

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- Rational selfish subjects maximize individual earnings
- Each subject covers the full ***cost*** of her contribution
- Each subject gets 1/n of the ***benefit***
- Free riding behavior
- Groups in real life trust on an external third party with the right to be coercive or use enforcement mechanisms (communication, private goods, sanctions)

Tragedy of the Commons

EXTRA SLIDES

Common Resources
Tragedy of the Commons

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- The Problem of the Commons
  - The problem of the commons is the absence of incentives to prevent the overuse and depletion of a commonly owned resource.
  - Examples include the Atlantic Ocean cod stocks, South Pacific whales, and the quality of the earth's atmosphere.

- Like public goods, common resources are not excludable.
  - cannot prevent free riders from using
  - little incentive for firms to provide
  - role for govt: seeing that they are provided

- Additional problem with common resources: rival in consumption
  - each person's use reduces others' ability to use
  - role for govt: ensuring they are not overused

Common Resources
Tragedy of the Commons

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- A metaphor: herders/fishers sharing a common parcel of land/sea (the commons), and they are all entitled to let their cows graze/fish with their boats

- It is in each herder's interest to put as many sheep/boats as possible onto the land/sea, even if the commons is damaged as a result

- Each of them receive the benefits from the additional sheep/boat, while the damage to the commons is shared by the entire group

- If they all make this individually rational decision, the commons is destroyed and all suffer

Common Resources

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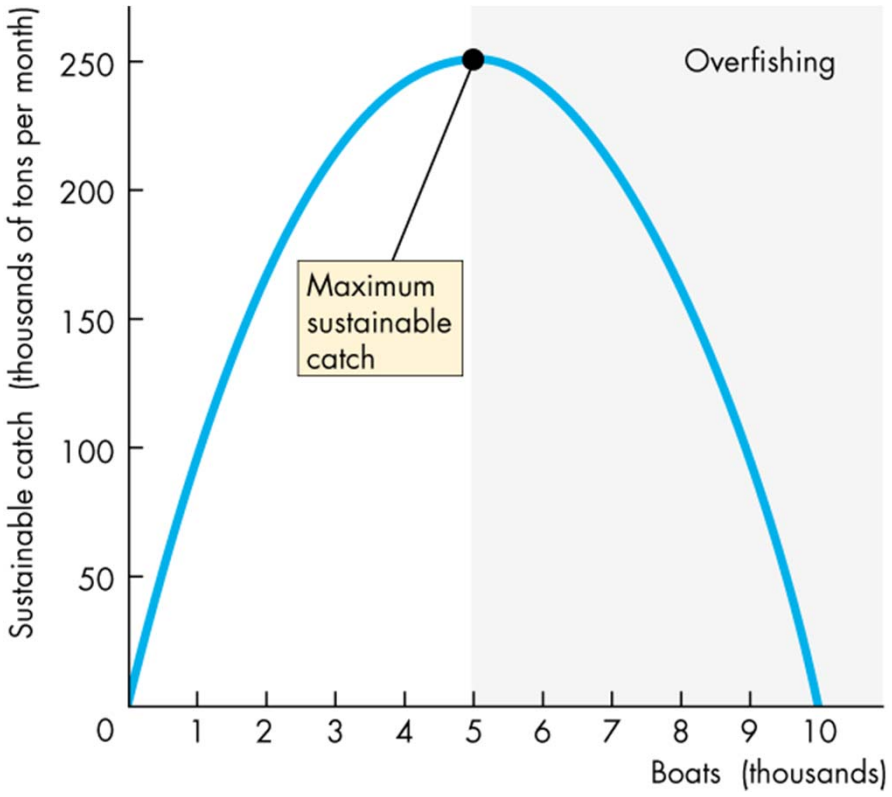
- Sustainable Production
  - Figure shows production possibilities from a common resource.
  - As the number of fishing boats increases, the quantity of fish caught increases to some maximum.
  - Beyond that maximum, the sustainable catch decreases.



Common Resources

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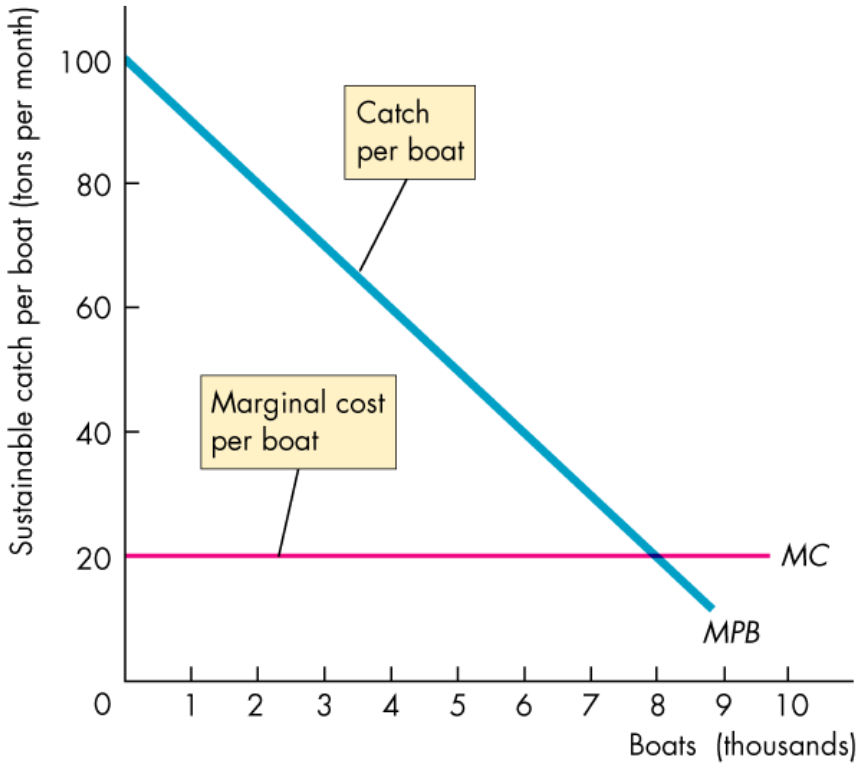
- An Overfishing Equilibrium
  - Figure shows why a common resource get overused.
  - The average catch per boat, which is the marginal private benefit, *MPB*, decreases as the number of boats increases
  - The marginal cost per boat is *MC* (assumed constant)



Common Resources

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- The Efficient Use of the Commons
  - The quantity of fish caught by each boat decreases as the number of boats increases.
  - But no one has an incentive to take this fact into account when deciding whether to fish.
  - The efficient use of a common resource requires marginal cost to equal marginal *social* benefit.

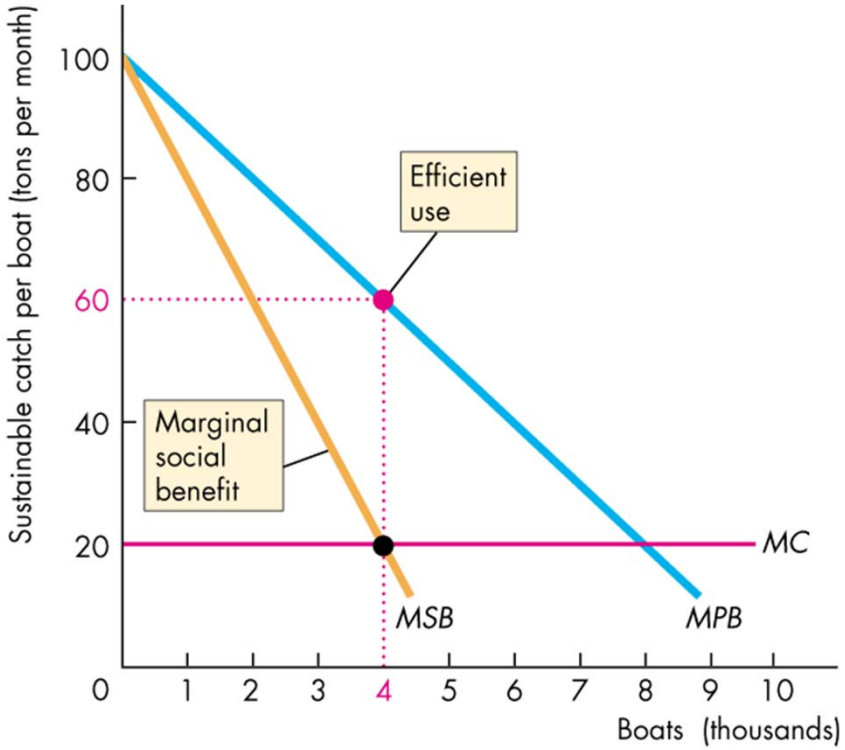
Common Resources

Marginal social benefit is the increase in total fish catch that results from an additional boat, not the average catch per boat

Figure shows the efficient use of a common resource.

The marginal social benefit curve, *MSB*, is below the *MPB* curve

The resource is used efficiently when *MSB* equals *MC*.



Common Resources

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- Achieving an Efficient Outcome
  - It is harder to achieve an efficient use of a common resource than to define the conditions under which it occurs.
  - Three methods in use are:
    - Property rights
    - Quotas
    - Individual transferable quotas (ITQs)

Common Resources

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- Property Rights
  - By assigning property rights, *common* property becomes *private* property.
  - When someone owns a resource, the owner is confronted with the full consequences of her/his actions in using that resources.
  - The social benefits become the private benefits.

Common Resources

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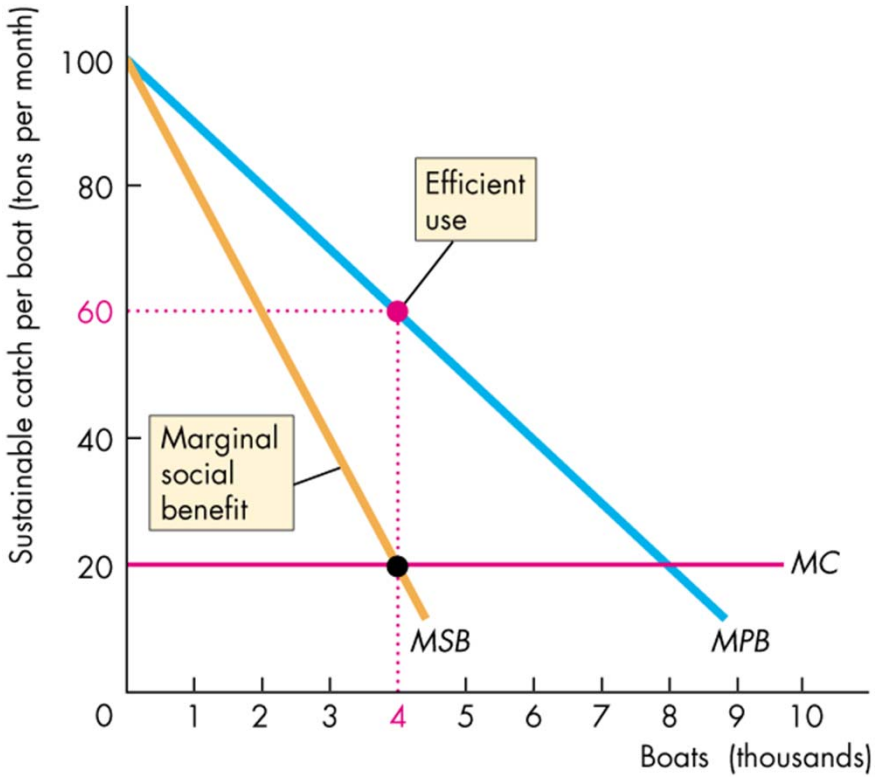
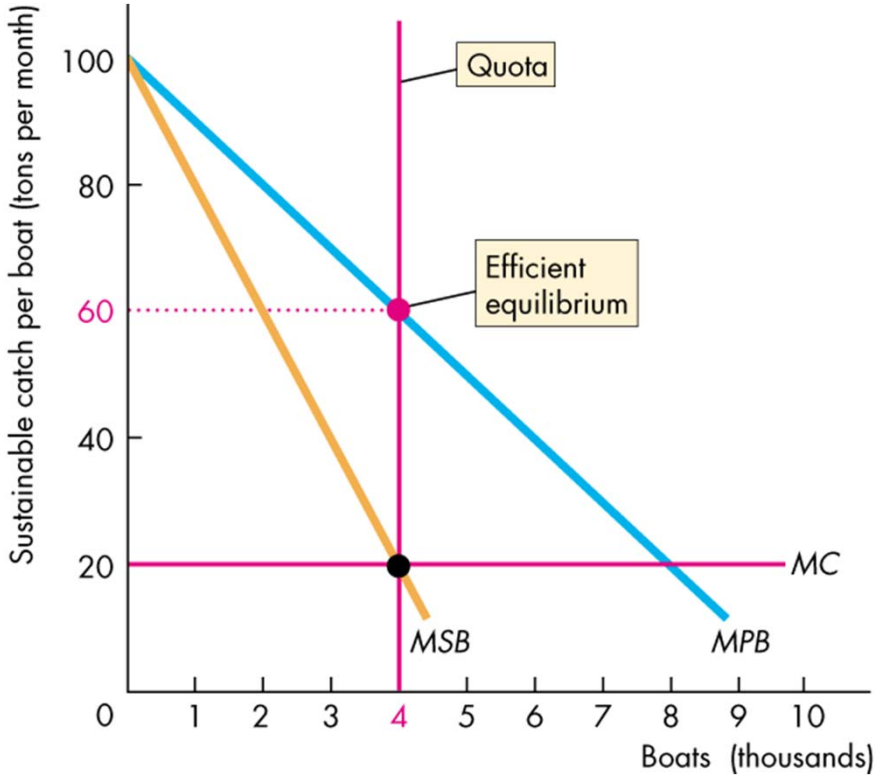
- In the figure, the marginal social benefit curve, *MSB*, becomes the *marginal private benefit* curve.
- The resource is used efficiently because the owner of the resources is best off when *MSB* equals *MC*.



Common Resources

- Quotas
  - By assigning setting a production quota at the efficient quantity, a common resource might remain in common use but be used efficiently.
  - Figure shows this situation.
  - It is hard to make a quota work.



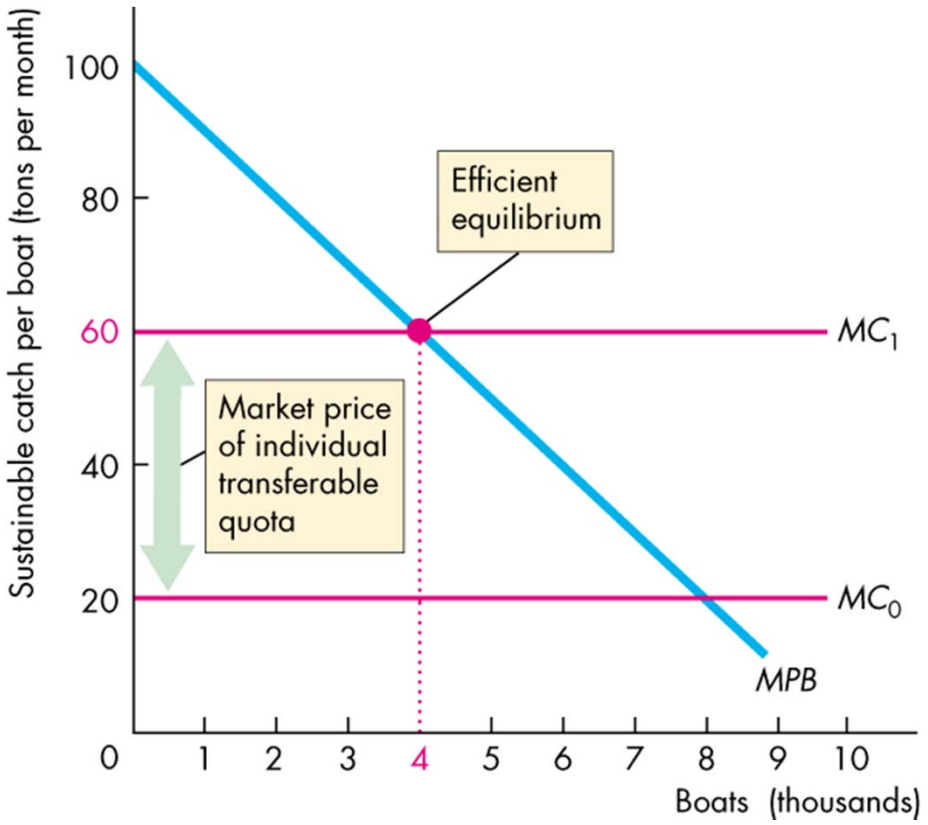
Common Resources

- Individual Transferable Quotas
  - An **individual transferable quota (ITQ)** is a production limit that is assigned to an individual who is free to transfer the quota to someone else.
  - A market emerges in ITQs.
  - If the efficient quantity of ITQs is assigned, the market price of a quota confronts resource users with a marginal cost that equals *MSB* at the efficient quantity.

Common Resources

Marginal cost rises from MC_0 to MC_1.

Users of the resource make marginal private benefit, *MPB*, equal to marginal private cost, MC_1, and the outcome is efficient.



Takeaway messages

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- Public goods: non excludable and non rival consumption
- Public goods are under provided by the market (market failure): room for government
- Tragedy of the commons: over exploitation of common resources