# MICROECONOMICS III
## CLASS 6

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# PRIVATE GOODS

**Excludable:** Consumption of the good by one individual prevents another individual from consuming it.

**Rival:** There is competition between individuals to obtain the good.

Every consumer of the good can only consume as much of it as he acquires for himself

# PUBLIC GOODS

**Non-excludable:** Nobody can be excluded from consumption of the good.

**Non-rival:** The same unit of a good can be used at the same time by every consumer.

A public good is delivered in the same amount to every consumer

# TYPES OF GOODS

| | Excludable | Non-excludable |
|---|---|---|
| Rival | <u>Private goods</u><br>food, clothing, phones | <u>Common-pool resources</u><br>coal, timber, public road |
| Non-rival | <u>Club goods</u><br>cinemas, private parks, cable television | <u>Public goods</u><br>air, national defense, biodiversity, stable climate, street lights |

# THE TRAGEDY OF THE COMMONS

A situation in a shared-resource system where every individual tries to get the greatest benefit from a given resource.

- Individuals act independently according to their self-interest

Goods to which there is unlimited access or which constitute common goods are overexploited

- The supplier of such a good cannot exclude anyone from using the good once it has been supplied

# THE TRAGEDY OF THE COMMONS

Example

- Seas and oceans are connected, and fish do not perceive any (political) boarders.
- Overfishing generates costs to everyone.
- It affects economic well-being of the communities who depend on fish for their way of life.
- The World Bank report (2017): Overfishing costs the world $83 billion annually in lost revenues.
- It also impacts the balance of life in the oceans

# THE TRAGEDY OF THE COMMONS

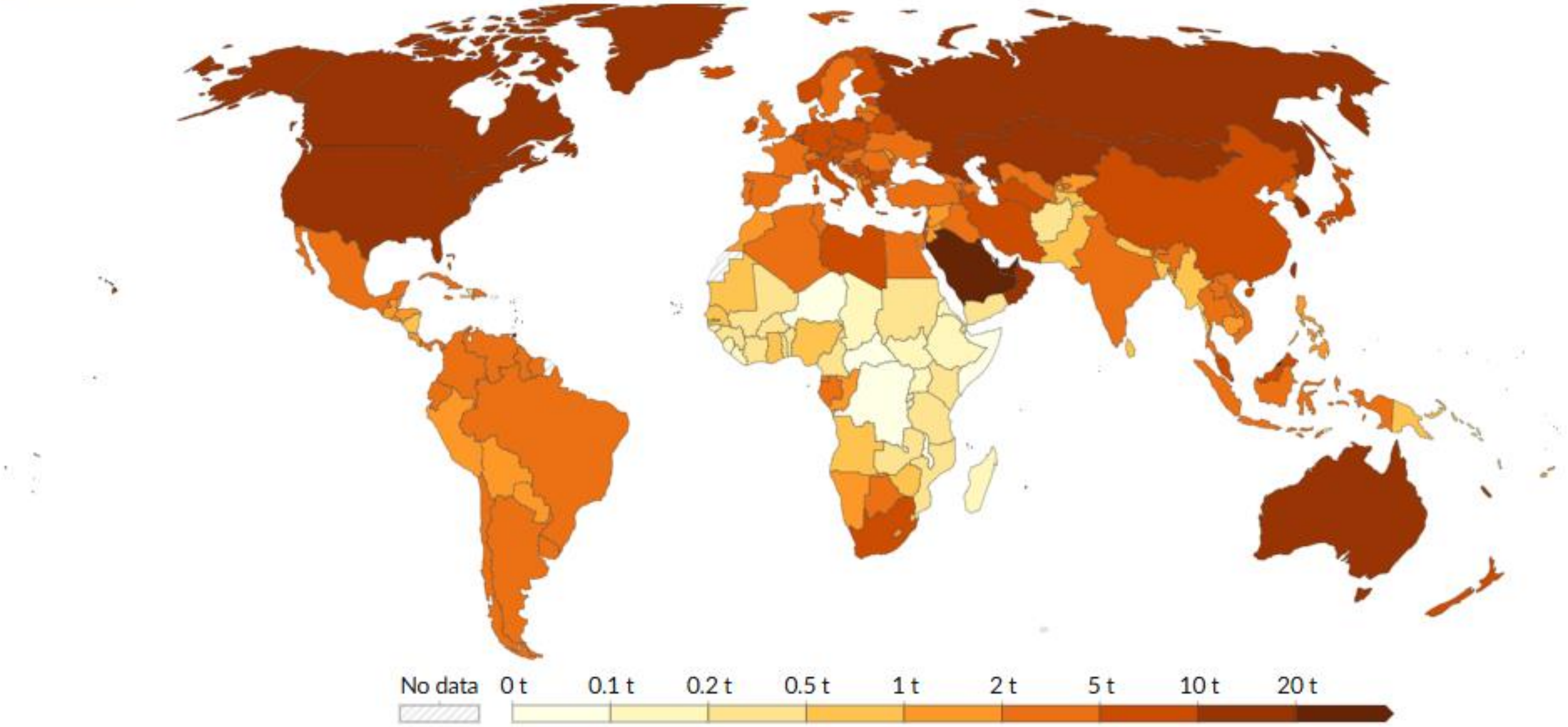
Example

- Greenhouse gas emissions has a planetary warming impact.
- The emissions affects only partially the country that emits.
- Hence, the emissions reach inefficiently high levels.
- There are attempts at international agreements, but there is still an incentive to breach.

# Per capita $CO_2$ emissions, 2023

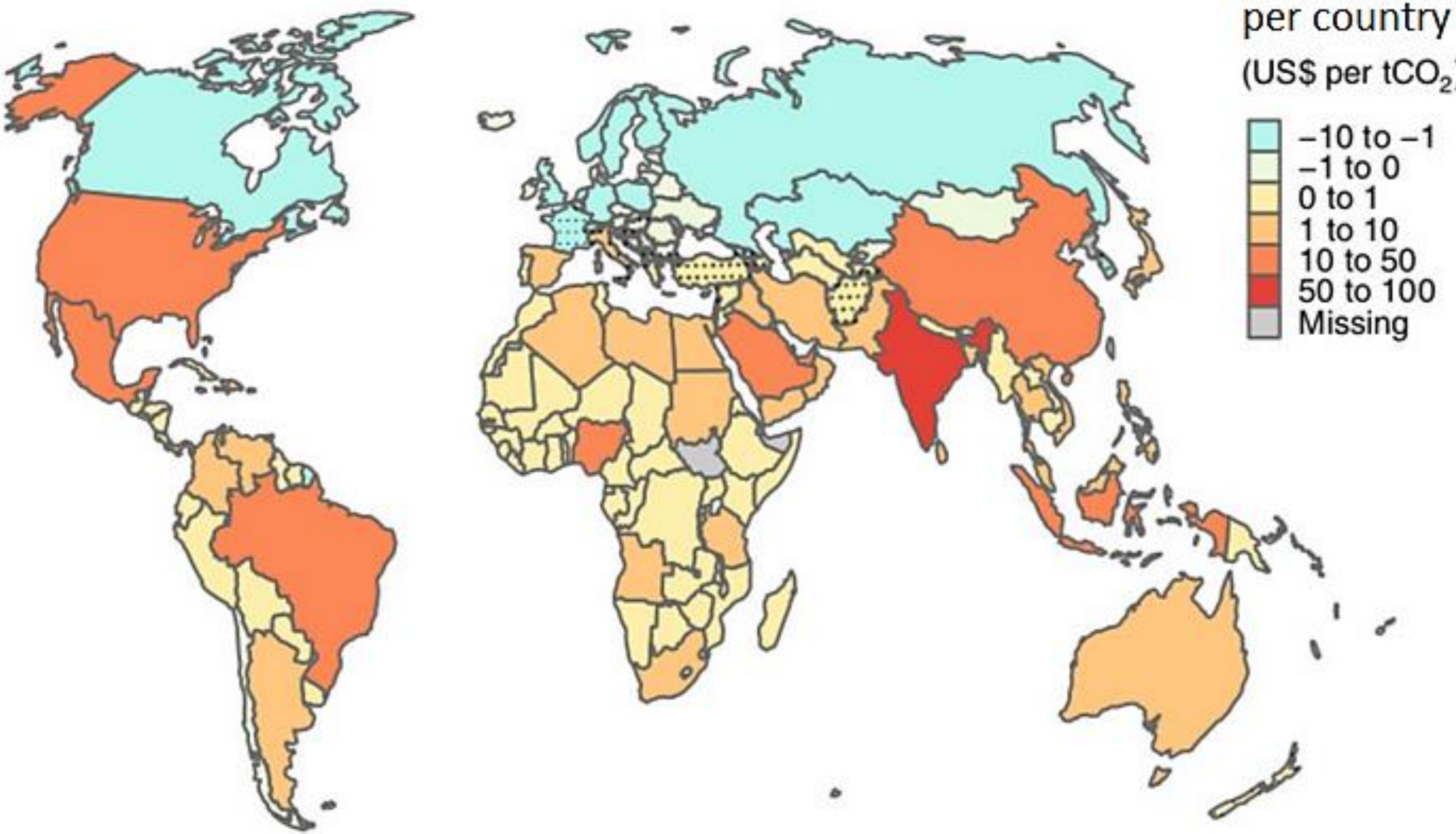
Carbon dioxide ($CO_2$) emissions from fossil fuels and industry. Land-use change is not included.

Table | Map | Chart



# Carbon social cost per country

(US$ per $tCO_2$)




The social cost of carbon for individual countries in dollars per ton of carbon dioxide emissions. | Nature Climate Change

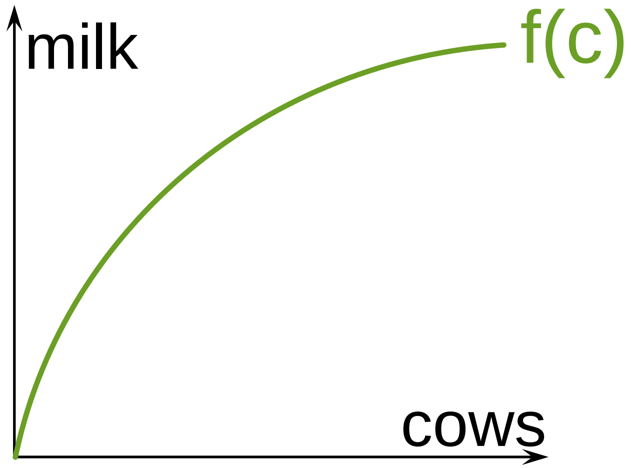
# THE TRAGEDY OF THE COMMONS: EXAMPLE

Consider a grazing area owned "in common" by all members of a village.

- Villagers graze cows on the common.
- When c cows are grazed, total milk production is f(c), where f'>0 and f''<0.

<u>How should the villagers graze their cows so as to maximize their overall profit?</u>

- How much cows will actually graze in the common area?



# THE TRAGEDY OF THE COMMONS: EXAMPLE

The reason for the tragedy is that when a villager adds one more cow his profit rises (by $f(c)/c - p$) but every other villager's profit falls

- They create an externality, similar as with congestion

The villager who adds the extra cow takes no account of the loss inflicted upon the rest of the village

# MORE EXAMPLES

Overfishing

Over-logging forests on public lands (e.g., Amazonia)

Over-intensive use of public parks (e.g., Yellowstone)

Urban traffic congestion

# PUBLIC GOODS

A consumer's reservation price for a unit of a good is his maximum willingness-to-pay (WTP) for it:

- Consumer's wealth is w
- Utility of not having the good is $U(w,0)$.
- Utility of paying p for the good is $U(w-p,1)$.
- Reservation price r is defined by

$$U(w,0) = U(w-r,1).$$

- Example: $U(x_1, x_2) = x_1(x_2+1)$.

# PUBLIC GOODS

When should a public good be provided?

- A public good costs c.
- Two consumers, A and B.
- Individual payments for providing the public good are X and Y.
- $X+Y>c$ if the good is to be provided.
- Utility of the consumers depends on money and the public good provision.

# PUBLIC GOODS

Payments must be individually rational:

$$U_A(w_A, 0) \le U_A(w_A - X, 1)$$

$$U_B(w_B, 0) \le U_B(w_B - Y, 1).$$

Reservation prices must be higher than the necessary payments

- Otherwise, it not feasible to supply the public good

If the inequalities are strict, then the public good provision is a Pareto improvement

# FREE-RIDING

Suppose A reservation price is higher than c, but B reservation price is lower than c

- Then, A would supply the good even if B made no contribution.

B can enjoy the good for free: B is a free-rider.

**Free-riding** – consumers avoid buying a public good (and bearing the cost thereof), hoping that they can use the good that has been bought/provided by someone else

# FREE-RIDING

Suppose now that reservation prices of both, A and B, are lower than c

- Then, neither A nor B will supply the good alone.

Yet, if the sum of their reservation prices exceeds the cost then it is a Pareto-improvement for the good to be supplied.

<u>A and B may try to free-ride on each other, causing no good to be supplied</u>

# FREE-RIDING: EXAMPLE

Suppose A and B each have just two actions – individually supply a public good or not

- Cost of supply c = \$100.
- Payoff to A from the good's supply = \$80.
- Payoff to B from the good's supply = \$65.

\$80 + \$65 > \$100, so supplying the good is Pareto-improving

- But they take the decisions about the good's supply (purchase) individually.

# FREE-RIDING: EXAMPLE

| | | Player B | |
|---|---|---|---|
| | | Buy | Don’t buy |
| Player A | Buy | -\$20 -\$35 | -\$20 \$65 |
| | Don’t buy | \$80 , -\$35 | \$0 \$0 |

(Don’t buy, Don’t buy) is a unique Nash equilibrium.
But it is not Pareto-efficient.

# FREE-RIDING: EXAMPLE

Now assume that the consumers do not need to take the decisions individually, but they can purchase the good together.

- E.g., A contributes \$60 and B contributes \$40.
- Payoff to A from the good = 80-60 = \$20 > \$0.
- Payoff to B from the good = 65-40 = \$25 > \$0.

# FREE-RIDING: EXAMPLE

| | | Player B | |
|---|---|---|---|
| | | Contribute | Don't contribute |
| Player A | Contribute | **$20, $25** | **-$60  $0** |
| | Don't contribute | **$0  -$40** | **$0  $0** |

Two Nash equilibria: (Contribute, Contribute) and (Don't contribute, Don't contribute).

# FREE-RIDING: EXAMPLE

Allowing contributions makes supply of a public good possible, although no individual will supply the good alone.

- But what contribution scheme is best?
- Free-riding can persist even with contributions.

# VARIABLE LEVELS OF A PUBLIC GOOD

The more money is contributed to a public good, the better quality/the larger amount the public good will have.

- E.g., more TV programs broadcast, a larger area of a national park.

c(G) is the production cost of G units of a public good.

Two individuals, A and B, with money $w_{\mathbf{A}}$, $w_{\mathbf{B}}$.

- Private consumptions are $x_A$ and $x_B$

# VARIABLE LEVELS OF A PUBLIC GOOD

Budget allocations must satisfy

$$x_A + x_B + c(G) = w_A + w_B.$$

Pareto efficiency condition for the public good supply:

$$|\mathbf{MRS_A}| + |\mathbf{MRS_B}| = \mathbf{MC}(G).$$

$MRS_A$ and $MRS_B$ are A and B's marginal rates of substitution between the public good and the private consumption.

- So MRS denotes the marginal willingness-to-pay (in terms of decreasing the private consumption) for an extra unit of the public good.

# VARIABLE LEVELS OF A PUBLIC GOOD

Why is the Pareto efficiency condition for the public good supply:

$$|\mathrm{MRS}_A| + |\mathrm{MRS}_B| = \mathrm{MC}(G)$$

- The public good is non-rival in consumption, so one extra unit of the public good is fully consumed by both A and B.
- $|\mathrm{MRS}_A| + |\mathrm{MRS}_B|$ is the total payment by A and B of the private good that preserves both utilities if G is changed by one unit.
- $|\mathrm{MRS}_A| + |\mathrm{MRS}_B|$ indicates, e.g., how much of the private good will A and B give up together in order get one more unit of the public good G?

# VARIABLE LEVELS OF A PUBLIC GOOD

Suppose $|\mathbf{MRS_A}| + |\mathbf{MRS_B}| < \mathbf{MC}(\boldsymbol{G})$.

- The marginal cost of one more unit of the public good is higher than the amount A and B would pay for the unit.
- Reduction of G is a Pareto improvement.

In the opposite case: increase of G is a Pareto improvement.

# VARIABLE LEVELS OF A PUBLIC GOOD

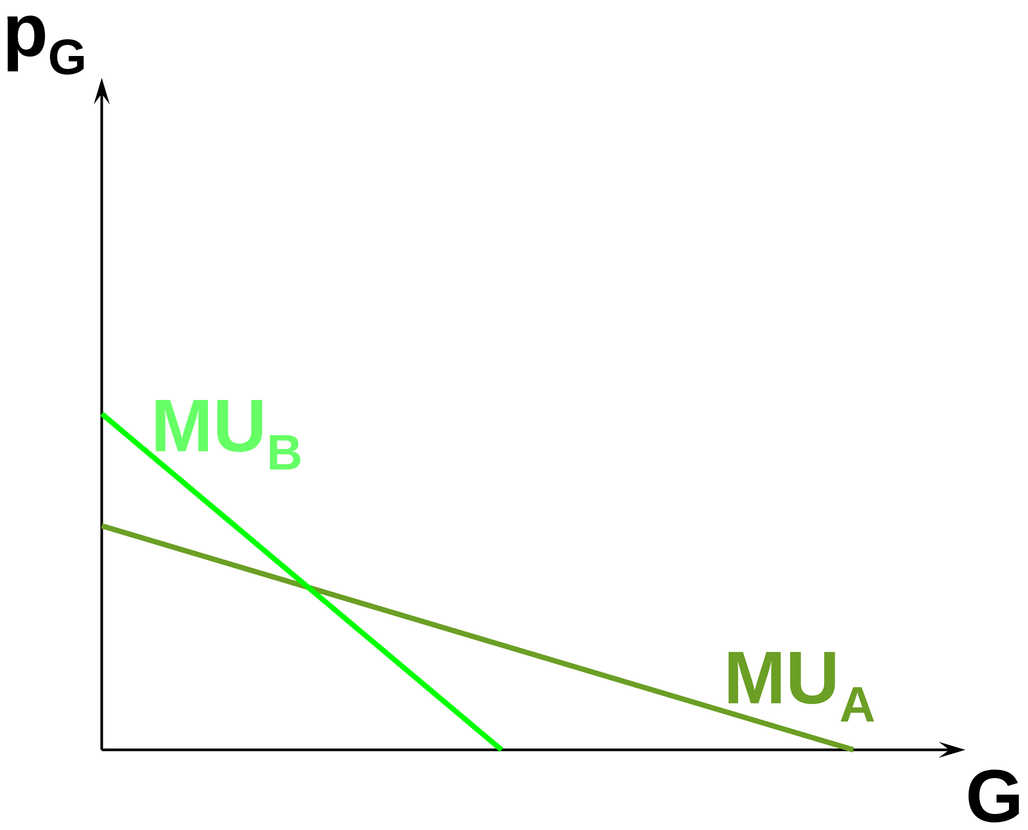
Suppose there are n consumers; i = 1,…,n. Then, the efficient public good supply requires”

$$\sum_{i=1}^{n} \left| \mathbf{MRS}_i \right| = \mathbf{MC}(G).$$

# EFFICIENT SUPPLY

Let us consider two individuals with quasi-linear preferences:

$$U_i(x_i, G) = x_i + f_i(G);\ i = \text{A,B}.$$



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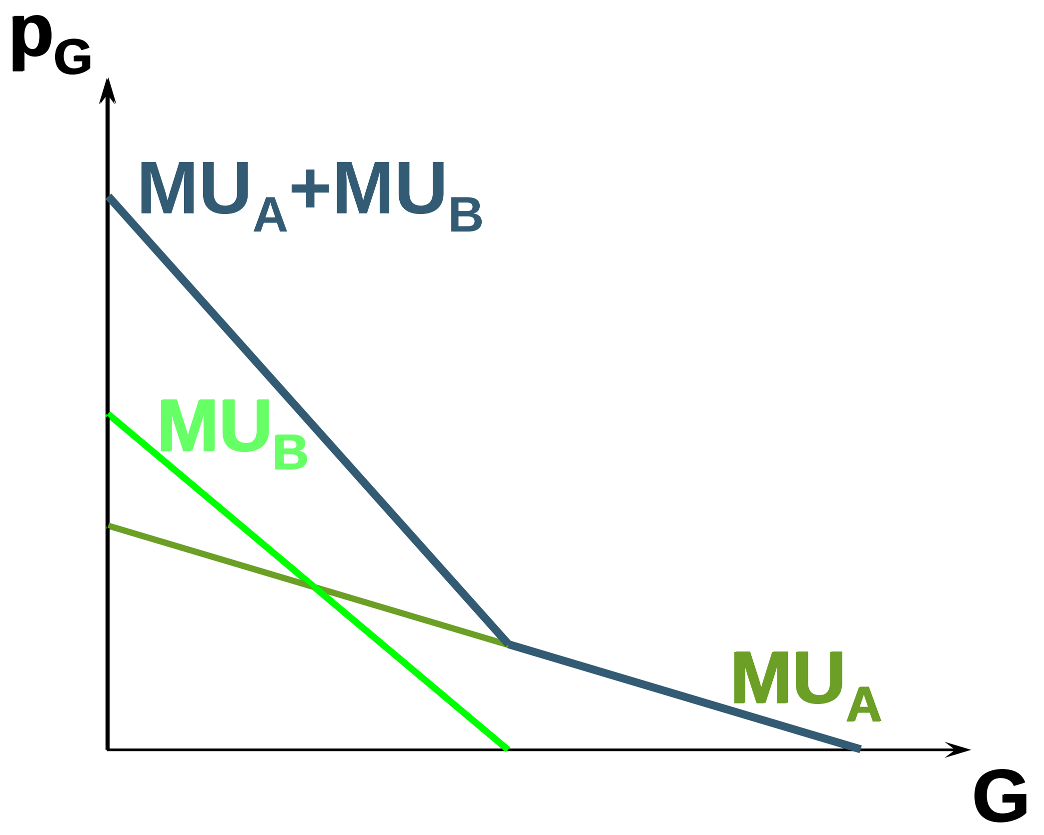

# EFFICIENT SUPPLY

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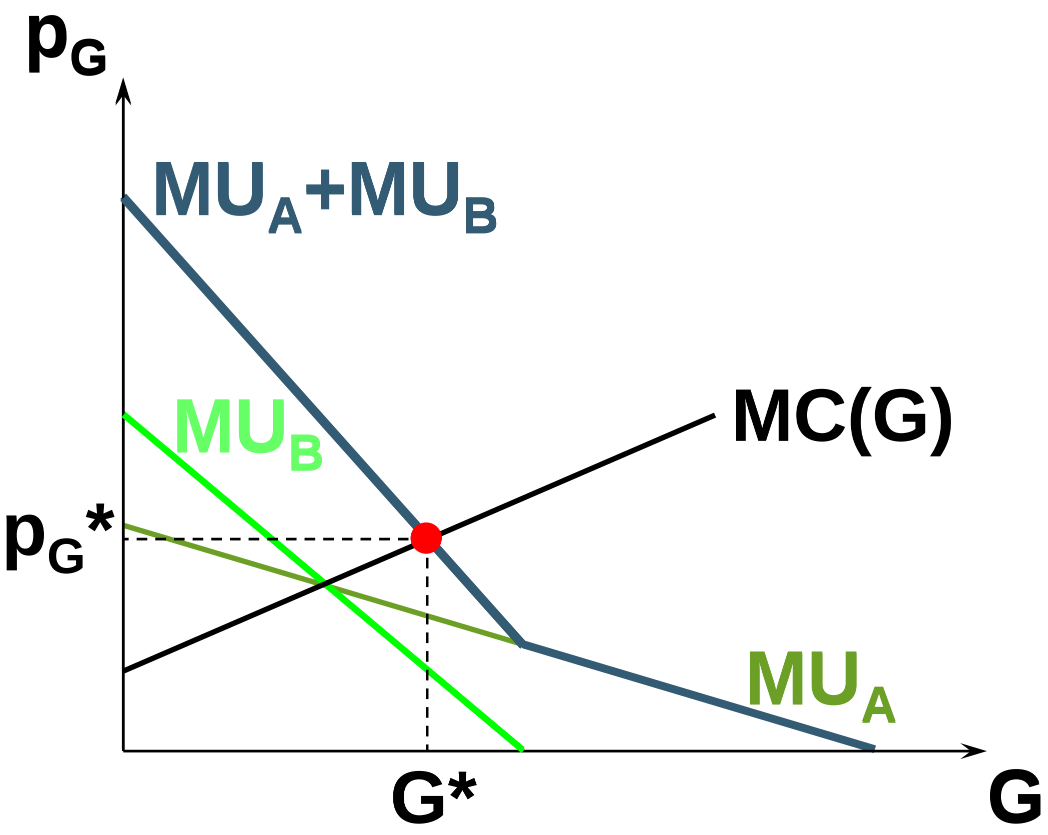
Efficient supply:

$$p_G^* = MU_{\mathrm{A}}(G^*) + MU_{\mathrm{B}}(G^*)$$



# PUBLIC GOODS AND MARKET SOLUTIONS

Decentralised market solutions (which are so much preferred by economists) do not work well in allocating public goods.

- People cannot acquire different amounts of a public good (e.g., national defense).
- They need to decide on a common amount.
- The amount of a public good supplied in equilibrium is too small compared to the effective supply of the good.