

TOPIC 4

Allocation

Public Provision for Economic Efficiency

*(b) Collective goods,
private property
and market failure*

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- The question is: what *mechanism* should we use to allocate resources in order to improve welfare of society?

First theorem of welfare economics

- If
1. Agents are competitive and take prices as parametric (no market power)
 2. There is perfect, symmetric information
 3. There is a full set of markets and no externalities (i.e. objective functions are independent)

Then The competitive equilibrium (if it exists) is pareto efficient

$$\frac{U'_1(x)}{U'_1(y)} = \frac{p_x}{p_y} = \frac{U'_2(x)}{U'_2(y)}$$

- Therefore a strong presumption that competitive markets are a mechanism that generates efficient allocations

- The first theorem assumes that all interactions between agents take place through the market.
- There are no interdependencies between agents outside of the market
- The interaction between individual consumption and production choices are mediated solely through prices.
- If so
 - Private costs and benefits (i.e. the marginal rate of substitution) reflect
 - Social costs and benefits of the same choices (i.e. relative prices)
- The prices that agents face in the market reflect true marginal costs and benefits to society
- Agents then make pareto improving exchanges until the gains from trade are exhausted and allocative efficiency results.

- Externalities arise when private costs and benefits are not signalled through the price mechanism
- Economic interactions between agents are *external* to the market mechanism
 - The interaction is direct - not mediated through price
 - Goods (or bads) with economic effects do not generate price signals
 - But economic benefits and costs do nevertheless appear in agent's objective function
- An externality can be interpreted as:
 - The price of something is wrong: it does not reflect the true marginal social cost or benefit of economic behaviour
 - A market is missing market: Property rights have not been assigned over some attribute or consequence of economic behaviour and therefore it cannot be traded
- The result is that there are 'non-market' interdependencies between agents

An example: A production externality

- A firm produces steel (s) and this operation generates pollution (x) which is dumped in a river. A second firm is a fishery located downstream

	Steel firm	Fishery
Cost function	$c_S(s, x)$	$c_F(f, x)$
Objective function	$\max_{s,x} p_S s - c_S(s, x)$	$\max_f p_f f - c_F(f, x)$
First order conditions	$c'_S(s) = p_S$ $c'_S(x) = 0$	$c'_F(f) = p_f$

- The steel firm produces pollution to the point where its marginal cost is zero (because there is no price)
- ... but the quantity of pollution shifts the fisheries cost curve upwards
- The private marginal cost of pollution to the steel firm does not reflect its social marginal cost

A possible solution

- Let's merge the firms into a single firm with two divisions but a combined objective function

Steel and fish firm

Objective function

$$\max_{s,f,x} p_s s + p_f f - c_s(s, x) - c_f(f, x)$$

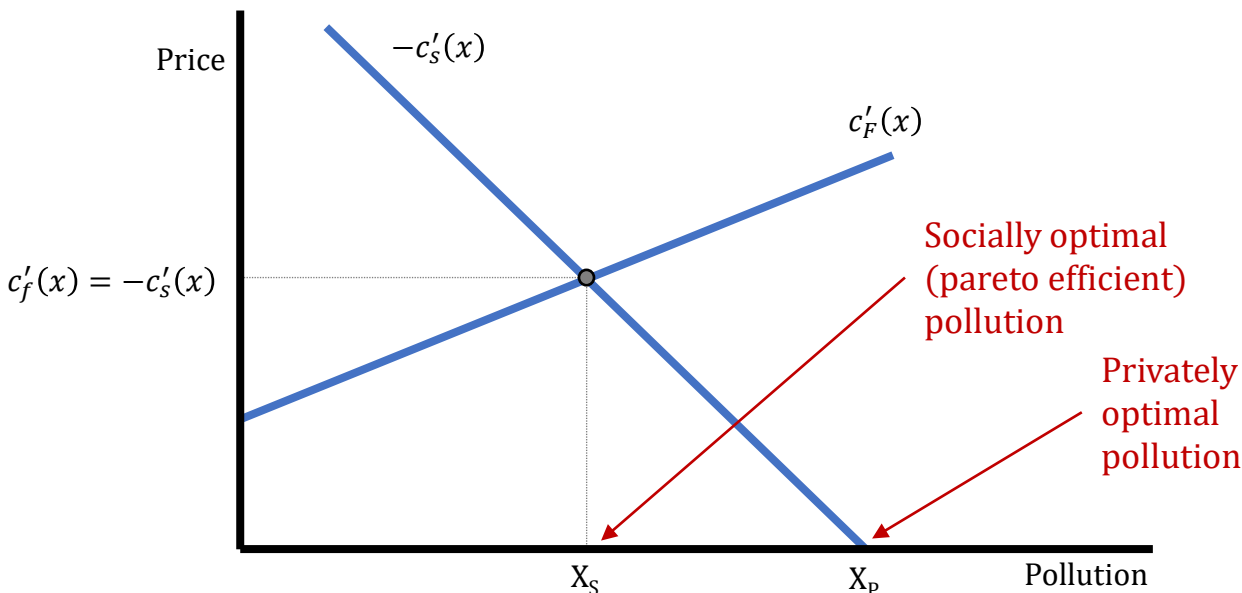
First order conditions

$$c'_s(s) = p_s$$

$$c'_f(f) = p_f$$

$$c'_s(x) + c'_f(x) = 0 \quad \text{or} \quad c'_f(x) = -c'_s(x)$$

- The last term means that the firm will take account of the marginal cost of pollution on both steel and fishing operations (i.e. some balance between $c'_s(x) < 0$ and $c'_f(x) > 0$)



Note that the profits of the merged firm exceed the profits of the two separate firms

- The efficient level of output is obtained through a merger:
 - The privately optimal level of pollution was not pareto efficient – there were unexploited gains from trade
 - The existence of these unexploited gains may “signal” the need for a merger (but it is not signalled through the price mechanism in the current example)
- The merger solution aligned private costs and social costs by internalizing the externality within a single firm.
 - This implied extinguishing the market mechanism and replacing with a bureaucratic mechanism
 - A market relation characterised by voluntary interaction between agents, decentralised choices, and spontaneous order arising from price signals
 - A single firm with concentrated authority, bureaucracy, hierarchy and planning
- A different solution might be to impose a Pigouvian tax: here again an outside authority imposes the solution. Here the surplus (or gains from trade) is taken up by the state.
- A third solution would be to allocate property rights over pollution and create a new market
 - Market exchange depends on the property right to alienate a commodity
 - This also depends on state action – the allocation of property rights – with distributional consequences.
 - This preserves the market mechanism and allows trade to exhaust pareto improvements

Tragedy of the Commons

- An agricultural village with grazing on a common field
 - Total milk = $f(c)$: Output (the value of milk production) depends on the number of cows (c)
 - Each cow costs a which is a constant
 - Milk per cow is the average product: $f(c)/c$
- Two mechanisms: which one is efficient?

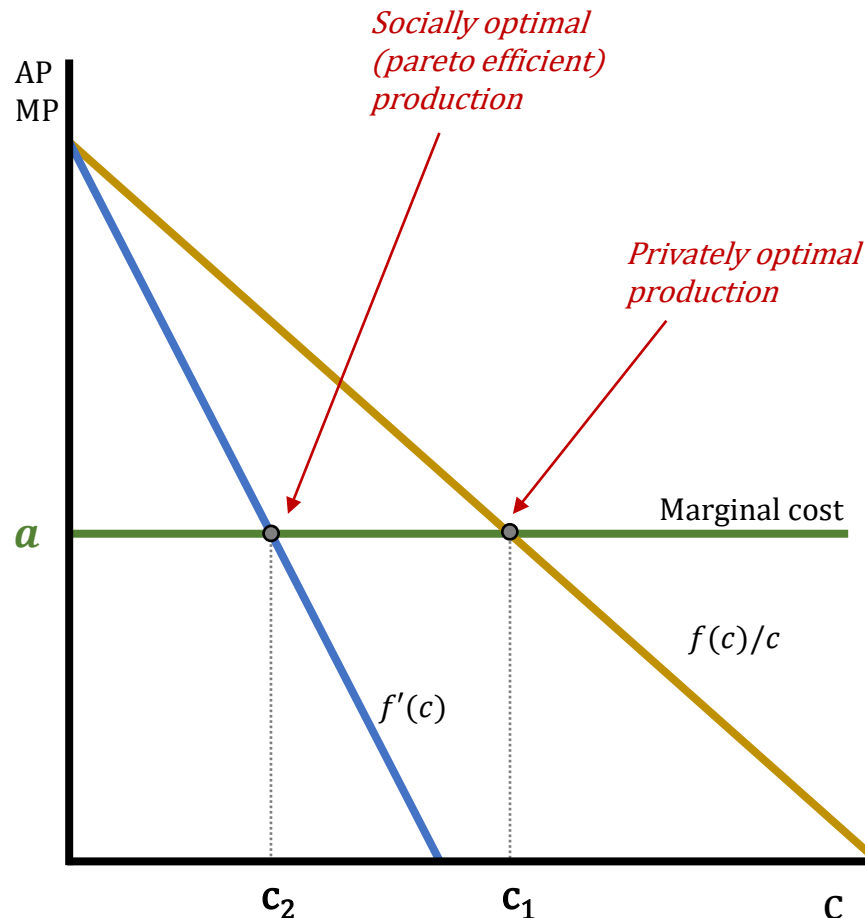
Common field (free entry)

- I will add another cow if $f(c)/c > a$ (the output of that cow is greater than its price)
- Graze until the average cow produces its own price

Private ownership (restricted entry)

- Choose c to max $f(c) - ac$
- $f'(c) = a$
- Graze until marginal cow produces its own price

- Social welfare is maximized under private ownership



- Again the absence of *private property* results a divergence between social and private cost.
- The decentralised solution has sub-optimal results
- The efficient solution is obtained through allocated the common pasture to a private owner, thus preserving the market mechanism, and enabling gains from trade.

- We can think of a public good a particular kind of consumption externality: one where everyone must consume the same amount of the good
- In the case of externalities, decentralised solutions are (in principle) available through the assignment of property rights:
 - Consumption externality: Assign and define the property right
 - Production externality: Market signals the resolution of the externality (merger)
 - Common property: Privatise the resource to eliminate the inefficiency
- But there are cases where it is impossible to assign property rights, and these are called public goods
- In the case of a public good, agents cannot choose individual levels of consumption.
 - Non-excludable: It is impossible to exclude anyone else from consuming the good (so alienable property rights cannot be assigned)
 - Non-rival: my consumption does not reduce availability of the good
- Once the good is provided the same amount is consumed by all, regardless of preferences (e.g. national defence)
- Since property rights to the benefit cannot be assigned (no excludability) your benefits are independent of your contribution.

Efficient allocation of public goods example

- Two consumers contribute to cost of a public good $g_1 + g_2 \geq c$
- If they their contributions reach c then $G = 1$, if not $G=0$

	Consumer 1	Consumer 2
Budget constraint	$x_1 + g_1 = w_1$	$x_2 + g_2 = w_2$
Utility	$U_1(x_1, G)$ or $U_1(w_1 - g_1, G)$	$U_2(x_2, G)$ or $U_2(w_2 - g_2, G)$
Reservation price	$r_1 \mid U_1(w_1 - r_1, 1) = U_1(w_1, 0)$	$r_2 \mid U_2(w_2 - r_2, 1) = U_2(w_2, 0)$

- The reservation price is maximum willingness to pay, and note that it depends on initial wealth
- Two states of the world
 - [1] No public good: $[w_1, w_2, 0]$
 - [2] Public good: $[x_1, x_2, 1]$ ($x_1 = w_1 - g_1$ and $x_2 = w_2 - g_2$)
- Is [2] a pareto improvement on [1]? If the answer is yes, it must be that:

$$U_1(w_1, 0) < U_1(x_1, 1)$$

which means: $U_1(w_1 - r_1, 1) = U_1(w_1, 0) < U_1(x_1, 1) = U_1(w_1 - g_1, 1)$

- So, if the provision of the public good is a pareto improvement:
 - Necessary condition $r_1 > g_1$ and $r_2 > g_1$
 - Sufficient condition: $r_1 + r_2 > g_1 + g_2 = c$

- The **sum** of **willingnesses to pay** > **cost of provision**

- Lets change G from a binary variable to a function of contributions, which we can think of as a production function

$$G = f(g_1 + g_2)$$

- Instead of 0 or 1 it now enters utility functions as a variable

$$U_1(x_1, G) \quad \text{or} \quad U_1(w_1 - g_1, G) \qquad U_2(x_2, G) \quad \text{or} \quad U_2(w_2 - g_2, G)$$

- *Non rival*: both consume the same amount (G) which is the total production in terms of $f()$
- *Non-excludable*: Consumption is independent of individual contribution; it is a function of the total contribution
- We can fix consumer 2's utility at some level (\bar{U}_2), insert the budget constraint ($x_i = w_i - g_i$) are inserted into the objective functions and optimize for consumer 1

$$\max_{g_1, g_2} [U_1(w_1 - g_1, G) + U_2(w_2 - g_2, G)] \qquad \text{s.t.} \qquad U_2 = \bar{U}_2$$

- Or equivalently

$$\max_{g_1, g_2} [U_1(x_1, G) + U_2(x_2, G)] \qquad \text{s.t.} \qquad U_2 = \bar{U}_2$$

- Which solves as

$$\frac{U'_1(G)}{U'_1(x_1)} + \frac{U'_2(G)}{U'_2(x_2)} = \frac{dG}{dx}$$

- The efficient provision is found where the sum of willingnesses has become the sum of marginal rates of substitution, and the cost of provision is the marginal rate of transformation

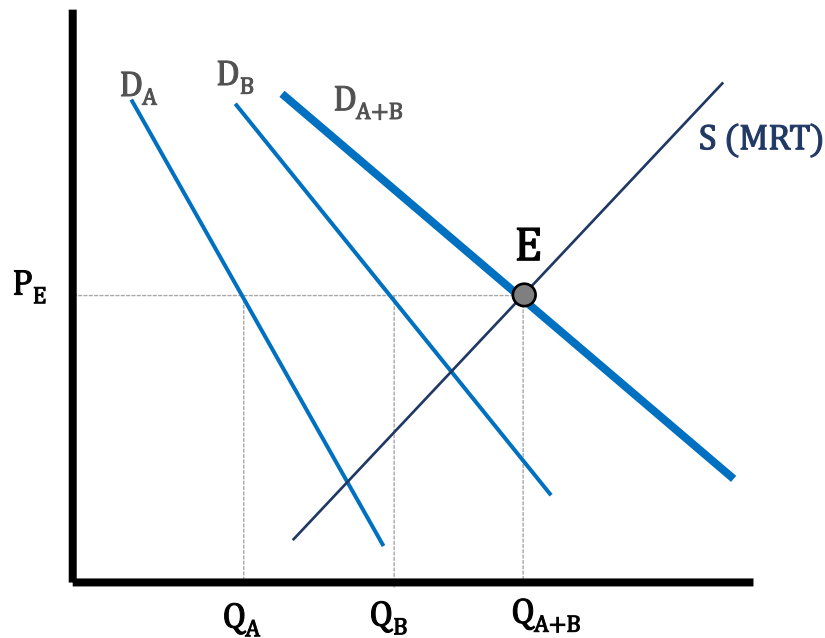
$$\frac{U'_1(G)}{U'_1(x_1)} + \frac{U'_2(G)}{U'_2(x_2)} = \frac{dG}{dx}$$

- The marginal rate of substitution of private goods for public goods tells how much private good each individual is willing to give up for one more unit of the public good.
- The sum of the marginal rates of substitution tell us how much of the private good all members of society together are willing to give up to get one more unit of the public good, (consumed jointly by all)
- The marginal rate of transformation tells us how much of the private good must be given up to produce one more unit of the public good.
- Efficiency requires that the total amount individuals are willing to give up – the sum of marginal rates of substitution – must equal the amount they have to give up – the marginal rate of transformation.

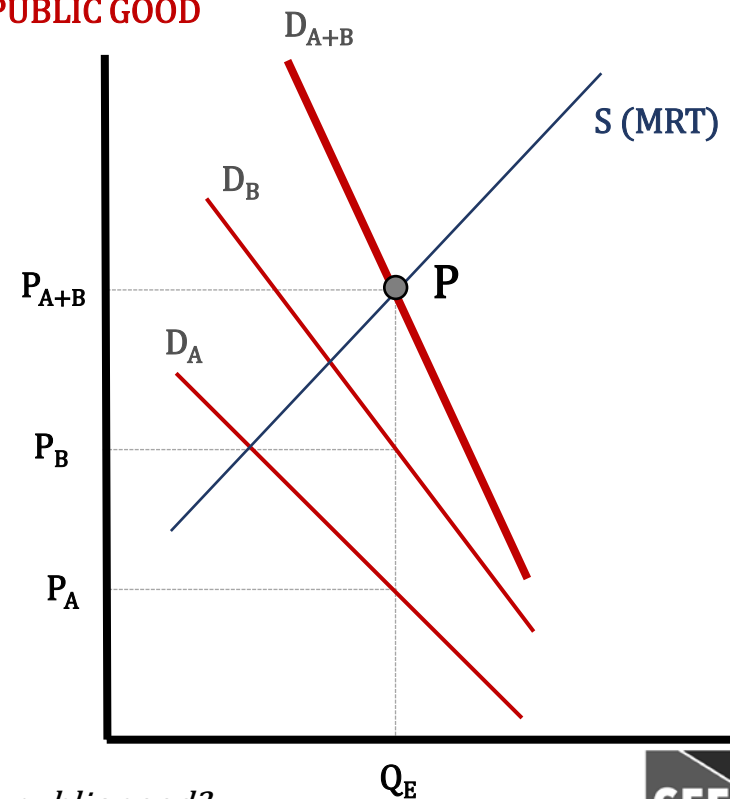
Efficient provision for private and public good

	Private good	Public good
Price	Same	Different
Quantity	Different	Same
Efficient provision	$MB_i = MC_i$ for all i	$\Sigma MB_i = MC$
Efficient pricing	$P = MC$	$\Sigma P = MC$

PRIVATE GOOD



PUBLIC GOOD



*Point E is a pareto-efficient equilibrium for a private good;
 Point P is pareto efficient, but what makes it an equilibrium for a public good?*

- We can identify the potential for pareto improvement and find the efficient level of provision
- But how will it come about?
 - What *mechanism* ensures the realization of pareto improvement
 - By definition we cant allocate a property right (non-excludable)
 - Can pareto improvements emerge from decentralized exchange?
- Lets assume that the sufficient condition is realised
- The sum of willingness to pay exceeds the cost of provision, so a payment plan is possible
- A numerical example:
 - Nobody can be excluded from watching TV
 - $r_1 = r_2 = R100$
 - $c = R150$
 - $r_1 + r_2 > c$
- Free riding is a dominant strategy
- If the two parties could cooperate they might contribute R75 each and both enjoy the R100 of benefit

Socially optimal*
It is socially rational to cooperate

		Player B	
		Pay	Free ride
Player A	Pay	25, 25	-50, 100
	Free ride	100, -50	0, 0

Privately optimal
Defection is a "dominant strategy".
It is individually rational to not contribute

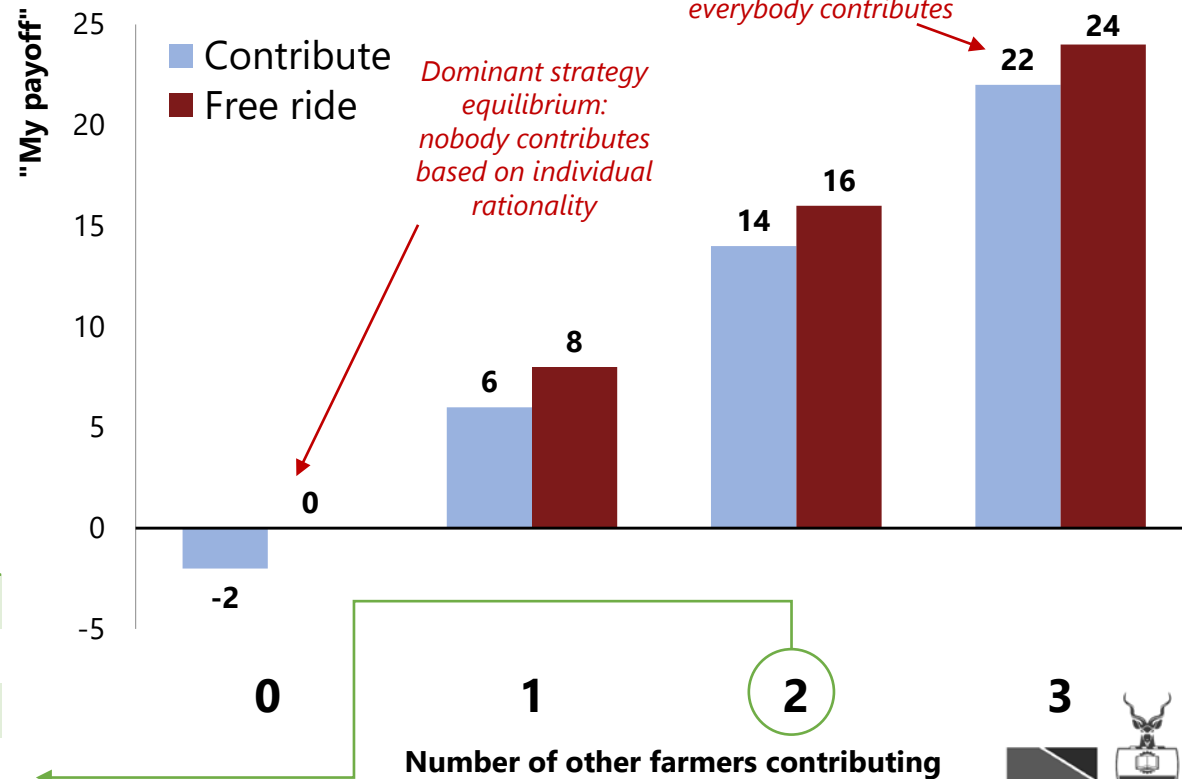
* Note that the sum of payoffs is equal in all outcomes except for (0,0) – they are all pareto efficient but not all equitable!

Irrigation

- Four small farmers share an irrigation system
- Contributing costs \$10 each: the minimum payment to for a worker to fix up leaks remove weeds etc.
- Better flow of water leads to improved crop yields for all users of the system
- For each \$10 contributed, all farmers get a benefit of \$8
- Each farmer decides independently, rationally, based on their own interests whether to contribute.



Socially optimal: outcome is where everybody contributes



Example if two others contribute

Payoff from not contributing	16
Cost of my contribution	-10
Benefit of my contribution for me	8
Payoff from contributing	14

- Since no one can be excluded they will not make voluntary payments, there is a case for public provision (“The government must step in”, says Musgrave, “and compulsion is called for”)
- If we know consumers preferences, we can decide the efficient level of provision (as per the example)
- But consumers will not reveal their true preferences : this is incentive incompatible
- How are the costs to be allocated? Can costs be assigned in line with preferences or strength of preference?
- Since markets fail as a device for registering consumer preferences, a political process must be used.
- Everyone will have to accept the same level of provision, regardless of their individual preferences.
- In this case, pareto improvements can only be achieved by a centralized coercive force imposing the solution on society (even if this is decided democratically)
- A decentralised solution is impossible, and the only mechanism we have to reveal preferences is voting.

- Technical attributes of goods can be located in one of these quadrants

<i>Attributes</i>	Rivalrous	Non-rivalrous
Excludable	Private good	Club good Toll good
Non-excludable	Common pool resource	Public good

- With different implications for:
 - Efficiency
 - Property rights and equity
 - Allocation mechanism: Price, user charges, general taxation.
 - Means of preference revelation
 - Production institutions (Firm, government, collective)
 - Accountability and measurement

Critical perspectives

- Neoclassical theory:
 - Economic world composed of ownable, exchangeable commodities
 - Independently constituted individuals who own the commodities initially, and certain wants that commodities can satisfy
 - What trades will arise and will they satisfy the wants and needs of the individuals?
 - Deductive method (“prior to the study of production and exchange relations themselves)
- The question: how to an account of certain non-market economic phenomena (e.g. public expenditure and taxation)?
 - An anomaly, a deviation from the general pattern of market-mediated economic relations
 - Why are private exchange relations not completely capable of expressing all economic relations?
- The answer:
 - For technical reasons (e.g. costs of exclusion) some commodities are not well suited to market exchange
 - These commodities can be provided efficiently provided by collective action
 - These technical problems are accidental; they fall arbitrarily on one or another of the commodities.

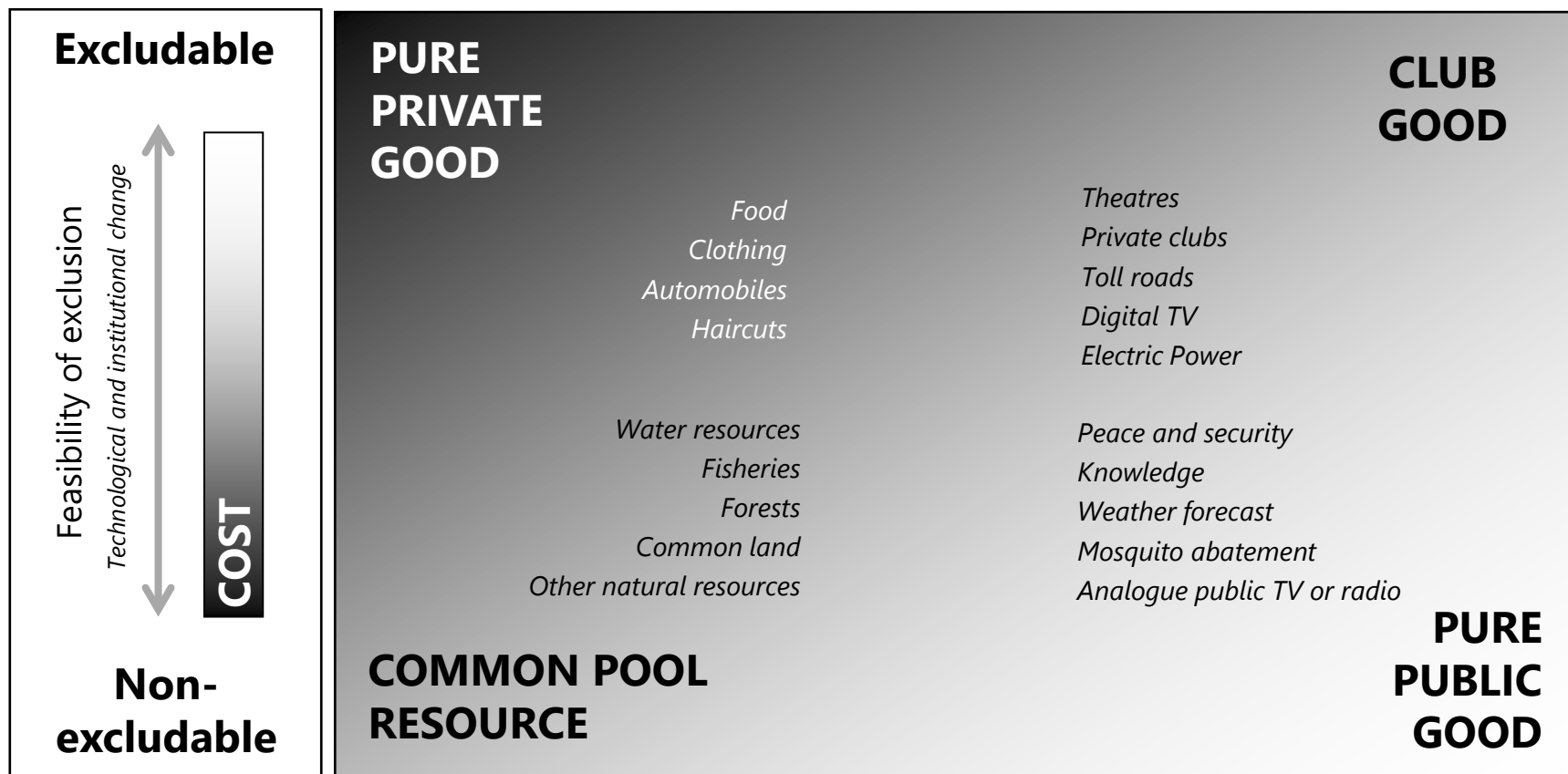
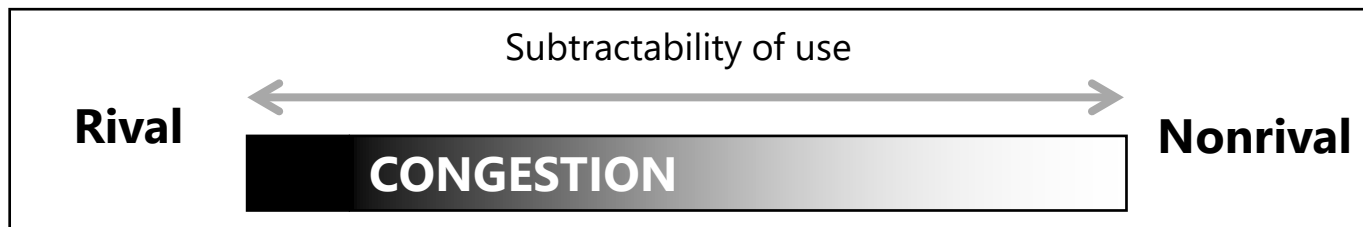
- A research agenda:
 - Characterizing those collective choices which best substitute for the market in meeting individual wants and needs while respecting individual ownership.
 - Designing mechanisms through which the individual commodity owners make collective choices.
- The solutions: the needs and wants of the independently constituted individuals, the commodities with their arbitrary given technical peculiarities, and some mechanism of information transfer and collective decision (e.g. voting) to determine the scope and direction of public expenditure.
- So, neoclassical economics is concerned with
 - the technical attributes of goods
 - The design of mechanisms for production and allocation in abstract logical terms
- Perhaps this is warranted for policy purposes ...
- ... but an alternative approach might focus instead on the study of production and exchange relations themselves, as a subset of human and social relations
- Perhaps we need to look at both the mud and the stars

- Smith: Order is an emergent property of self-seeking individuals
- Hobbes: Pursuit of self interest leads to conflict and disorder, which must be corrected by a leviathan state.
- Economics and political science evolve a simple-system, dichotomous world view
- Policy prescriptions tend to recommend Smith's concept of market order for all private goods and Hobbes's conception of sovereign state for all collective goods.
- "The state produces where the market fails"
- But:
 - The world is composed of complex systems, and very few goods are purely private or purely public goods
 - Showing that one institutional arrangement leads to sub-optimal performance is not equivalent to showing that another institutional arrangement will perform better.
- Market and state both fail to increase welfare in the increasingly complex domains of modern life.
- Consequently we need a richer set of formulations that "the" market and "the state

Adam Smith	Thomas Hobbes
Economics	Politics
Private goods	Public goods
Market	State
Decentralized	Hierarchical
Self-organisation	Coercion
Private property	Collective property
Consumers	Voters

A spectrum of goods

The world is composed of complex systems, and very few goods are purely private or purely public goods.



- Property rights \neq right of alienation
- Rather property rights have several economic dimensions:
 - Access
 - Withdrawal/harvest
 - Management (transform/regulate)
 - Exclusion (allocation of rights to access, withdrawal and management)
 - Alienation
- Ability of agents to self organise and build institutions that resolve these problems: Trust vs complete contracts
- Moving beyond the State/Market dichotomy, we can think of public economies composed of collective consumption units of varying size and institutional type.
 - “Wherever exclusion is problematic ... creating a collective consumption unit ...is essential to overcome problems of free riding and strategic preference revelation, to determine how costs will be shared among those who benefit, to arrange for production, and to regulate patterns of access, use, and appropriation.”
 - “The primary reason for using a form of collective organisation is to solve problems of provision. But once a collective consumption unit is established, how production is organised is an entirely separate question.”

- Provision is distinct from production
- Wherever exclusion is problematic, private rights to alienation are difficult to assign and collective consumption units are required for the social organisation of provision
- Collective consumption units
 - Collective organisations that solve problems of provision
 - Essential wherever exclusion is problematic
 - Overcome problems of free riding and strategic preference revelation
 - Determine how costs will be shared
 - Arrange for production
 - Regulate patterns of access, use, and appropriation.
- Once a collective consumption unit is established, how is production is organised?
- Institutional arrangements for production can include:
 - (1) own production by collective consumption unit
 - (2) contracting with a private firm
 - (3) contracting with another collective/government unit
 - (4) a mixture of the first three
 - (5) set standards, authorize producers and allow consumers to select and contract with suppliers
 - (6) issuing vouchers that allow consumers to purchase service from any authorized supplier.

- In capitalist society, markets are an important form of interdependence
- But only a sub-set of economic interdependencies are mediated through the market
- Many interactions where outcomes are inter-dependent
 - Externalities (your consumption imposes direct costs on me)
 - Common pool (your consumption choice erodes the value of our resources)
 - Public goods (your consumption is my consumption)
 - Agglomeration effects (my location affects your costs)
- In each of these the individual alienable property rights havenot/cannot be established:
 - A market can only really exist where property rights are clearly established
 - Missing market: can be resolved by creating a market
 - A wrong price can be resolved by assigned property rights
- But if we are not in the world of the first theorem of welfare economics, then
 - Allocations result from choices in which the preferences of each agent depending on the actions and preference of others
 - Final allocations are the outcome of strategic interaction and bargaining
 - We are in a second best world where correcting one distortion may be more than offset by distortions that emerge elsewhere in the system

