AE 503

PUBLIC GOODS

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- **With clearly specified property rights, there should be a market for an externality**

- **Not all externalities can be dealt with in this way - suppose a steel firm pollutes a river in which two individuals, A and B fish**

- **A and B have well-defined rights to clean water, so they have the potential to trade away some clean water in exchange for compensation from steel firm**

- **Critical problem is that A and B have to agree on how much pollution to allow, and what extent of compensation should be, given that:**

    - **they may have different degrees of sensitivity to how bad water pollution is**

    - **they have different preferences**

    - **they have different endowments of resources**

- **This is an example of a *public good* - water pollution is provided in *same* amount to all affected individuals; A and B may value water pollution differently, but each consume same amount**

- **Basic feature of public goods is that they are *non-rivalrous* in consumption, i.e. given the supply of a public good (bad), the consumption possibilities of one person do not depend on quantities consumed by others as is case with *private goods***

- **Markets often fail to supply public goods; well-known examples of such goods are:**

  - ***streets and highways* - usually supplied by local, state or federal government**

  - ***national defense* - usually supplied by federal government**

- **When to Supply a Public Good:**

  Suppose two individuals, 1 and 2, have to decide on whether to put up street lights in their housing development - key question is whether it is worth putting up lights

- **Individuals start with wealth of w_1 and w_2, g_1 and g_2 are their respective contributions to purchasing lights, and x_1 and x_2 are what is left over for consumption of private goods**

- **If cost of street lights is c, for lights to be set up, it must be case that:**

$$g_1 + g_2 \geq c$$

- **Utility functions are:**

$$U_1(x_1, G)$$

$$U_2(x_2, G)$$

G = 0 if there are no street lights, and G = 1 if there are lights

- **Each individual may value street lights quite differently; value can be measured in terms of how much each individual is *willing to pay* for street lights, i.e. their *reservation price***

- **Reservation price for each individual is maximum amount they are willing to pay for public good**

  - ☞ **it is that price r, where an individual is just indifferent between paying r and getting the street lights and not having the street lights and paying nothing:**

$$U_1(w_1 - r_1, 1) = U_1(w_1, 0)$$

$$U_2(w_2 - r_2, 1) = U_2(w_2, 0)$$

i.e. if individual 1 pays r_1 and gets street lights, they have $w_1 - r_1$ left to spend on private goods x_1, utility being just equal to not having street lights and spending all wealth on private goods

- **Individual reservation prices depend on wealth, i.e. maximum amount individual is *willing to pay* depends on their *ability to pay***

- **Under what conditions should street lights be purchased?**

  - ☞ ***necessary condition*:**

$$r_1 > g_1$$

$$r_2 > g_2$$

i.e. each individual's willingness to pay, as measured by their reservation price, should exceed actual payment they make to get street lights

  - ☞ ***sufficient condition*:**

$$(r_1 + r_2) \geq (g_1 + g_2) = c$$

i.e. sum of individuals' willingness to pay should be greater than or just equal to cost of purchasing street lights

- **Conditions imply two things:**
  - **provision of street lights depends only on willingness to pay and cost, i.e. if $(r_1 + r_2) \geq c$, there will always exist a payment scheme (g_1, g_2) where providing street lights is a Pareto improvement**
  - **r_1 and r_2 depend on initial distribution of wealth (w_1, w_2) - it is possible that $(r_1 + r_2) \leq c$**

- **Conditions outlined assume individuals truthfully reveal how much they value public good**

- **Each individual has incentive not to contribute to street lights - they hope other will go out and unilaterally purchase it, i.e. there is *free-riding*:**
  - **Initial wealth: $w_1 = w_2 = \$500$**
  - **Willingness to pay for lights: $r_1 = r_2 = \$300$**
  - **Cost of lights $c = \$400$, i.e. $(r_1 + r_2) > c$**

(see next figure)

INDIVIDUAL 2

		BUY	DON’T BUY
INDIVIDUAL 1	BUY	$600,$600	$400,$800
	DON’T BUY	$800,$400	$500,$500

- **Each individual writes on a piece of paper whether street lights should be purchased:**
  - **if both say buy, net value of consumption for each is \$600, i.e. lights cost each \$200, leaving \$300 each for private goods, and each values lights at \$300**
  - **if both say do not buy, each consumes \$500 of private goods**
  - **if individual 1 says buy, and 2 says do not buy:**

    - individual 1 is obligated to spend \$400 on purchasing lights, leaving \$100 for private goods and consumption of lights is valued at \$300, i.e. net consumption of \$400

    - individual 2 retains \$500 for private goods and gets \$300 worth of lighting, i.e. net consumption of \$800
- **Problem has structure of a *prisoners' dilemma*, i.e. each individual has an incentive to free-ride off the other, so dominant equilibrium will always be "do not buy"**

- **Allowing for many individuals, and given free-riding problem, likely to be under-supply of public goods which requires government intervention**

- **If government has to supply public goods, what is optimal amount to supply?**

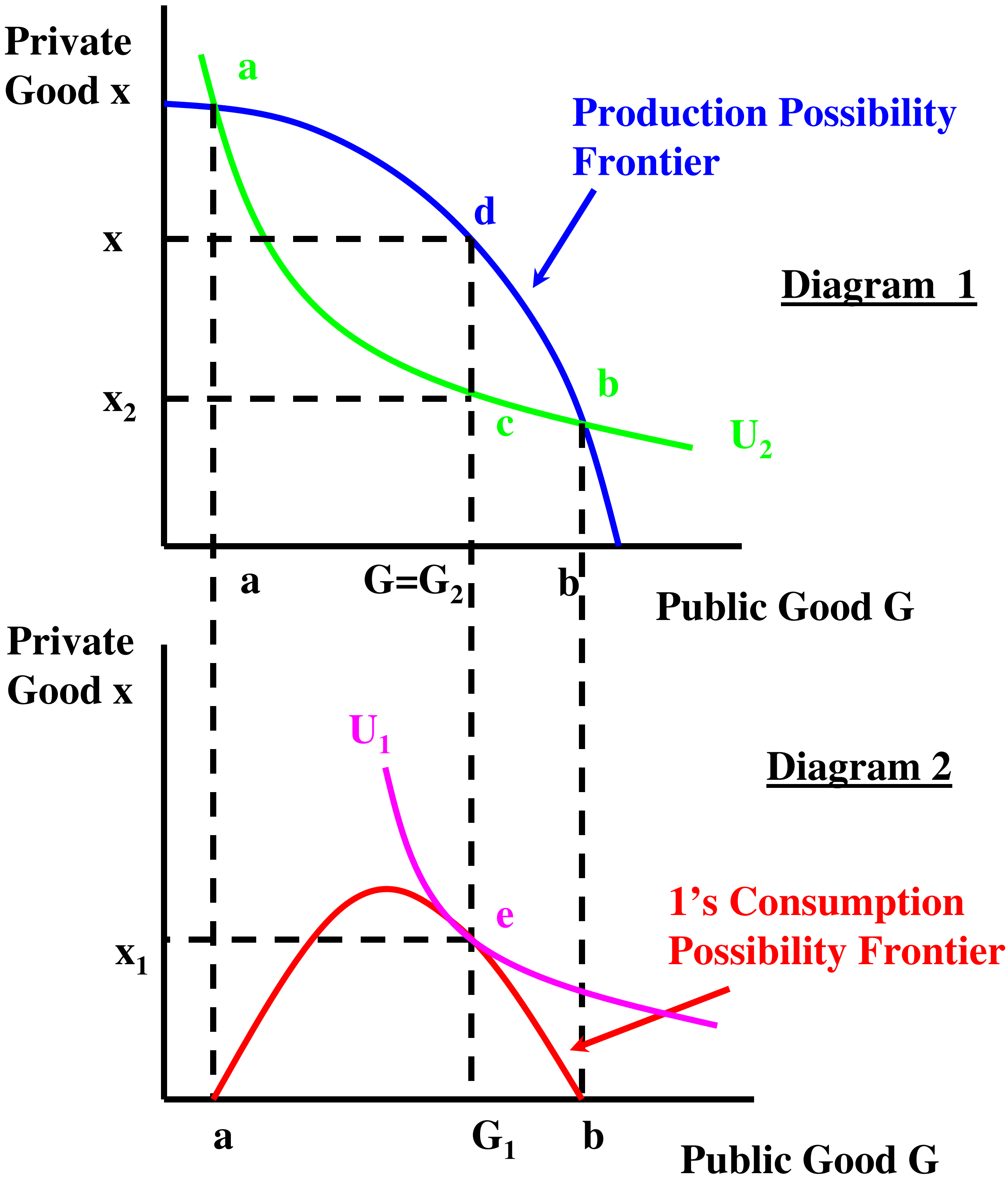
  - ☞ **Suppose economy consists of individuals 1 and 2, where consumption of *private good* is x_1 and x_2, and there is a *public good* giving a level of services G**

  - ☞ **In Diagram 1 there is a production possibilities frontier for the private and public goods**

  - ☞ **On this is imposed a fixed level of utility for individual 2, U_2**

  - ☞ **From points a and b where U_2 cuts the production frontier, points can be traced in Diagram 2**

OPTIMAL SUPPLY OF A PUBLIC GOOD



- **a and b imply certain levels of public good that can be consumed by both 1 and 2, i.e. *non-rivalry* in consumption - points a and b can be drawn in Diagram 2**

- **Between a and b in Diagram 1, each individual consumes same amount of public good - translates into points between a and b along horizontal axis in Diagram 2**

- **In terms of private good x, at a and b in Diagram 1, individual 2 gets all of the private good - at a and b in Diagram 2, individual 1 gets none of the private good**

- **Moving from a to b along U_2, individual 2's consumption of available private good falls then rises, while that of individual 1 rises and then falls along their consumption possibility frontier**

- **Amount of x available to individual 1 depends on gap between U_2 and the production frontier - it gets larger then smaller**

- **Optimal allocation from 1's point of view is where indifference curve U_1 is just tangent to consumption frontier at e**

  - **at point e, slope of 1's indifference curve is marginal rate of substitution MRS_1 between private and public good**

  - **slope of consumption frontier at e is a function of difference between slope of production frontier MRT, and slope of 2's indifference curve MRS_2, i.e. MRT - MRS_2**

  - **at point e:**

$$MRS_1 = MRT - MRS_2$$

which can be re-written as:

$$MRS_1 + MRS_2 = MRT$$

  - **if price of private good $p_x = 1$, MRT can be interpreted as price of public good p_G, which will be marginal cost in a competitive market**

- **What does condition for optimal supply of a public good mean?**

- **The marginal rate of substitution of the public good for the private good can be interpreted as an individual's *marginal willingness to pay* for an extra unit of the public good**

- **Condition means that the sum of the marginal willingness to pay for each consumer must equal the marginal cost of providing an extra unit of the public good**

- **In equilibrium, $G_1 = G_2 = G$ of the *public good* is supplied, and x of the *private good*, x_1 and x_2 being individual levels of consumption**