Public good: characteristics & aggregating demand curves

Definition – A pure public good is characterized by being both non-rivalrous in consumption and non-excludable. A good is non-rival when an individual's consumption of that good does not limit another individual's consumption of the same good. A good is non-excludable when there is no way to deny consumption of the good to an individual.

Source: Gruber, J. (2018). Public finance & public policy.

Intuition – Imagine a firework is set off high in the air so that everyone can see it. When the firework detonates high in the air, an unlimited number of people can enjoy the display. Furthermore, there is no way to limit others from viewing the firework, so it is impossible charge them for the enjoyment they received from the experience. Given that any single firework produced can entertain every viewer, local governments take the the sum of every individual viewers willingness to pay in order to determine the total amount of benefit that each additional firework provides.

Mathematical / Technical

- The aggregate demand curve for a private good is the total quantity demanded by all individuals at different price levels: more goods are needed to satisfy everyone.
- Thus, the aggregate demand curve for private goods is derived horizontally by summing individual quantities demanded at every price to produce a social marginal benefit curve. Begin with demand curves:

$$D_1: Q = y_1 - x_1 P \;;\; D_2: Q = y_2 - x_2 P$$

$$D_{agg}: Q_{agg}(P) = \sum D_{1,2} = (y_1 + y_2) - (x_1 P - x_2 P)$$

- The aggregate inverse demand for a public good is the total willingness to pay of all individuals at all possible quantity levels: any amount provided **simultaneously** satisfies everyone.
- Thus, aggregate demand curve (social marginal benefit, **SMB**) for public goods is derived by vertically summing individual demand curves. Vertical summation is necessary because of non-excludability — everyone can consume the same amount of the public good. Begin with **inverse** demand curves (marginal benefits, MB):

$$MB_1: P = y_1/x_1 - Q/x_1 \;;\; MB_2: P = y_2/x_2 - Q/x_2$$

$$\text{SMB(Q)} = \sum MB_{1,2} = (y_1/x_1 + y_2/x_2) - (Q/x_1 - Q/x_2)$$

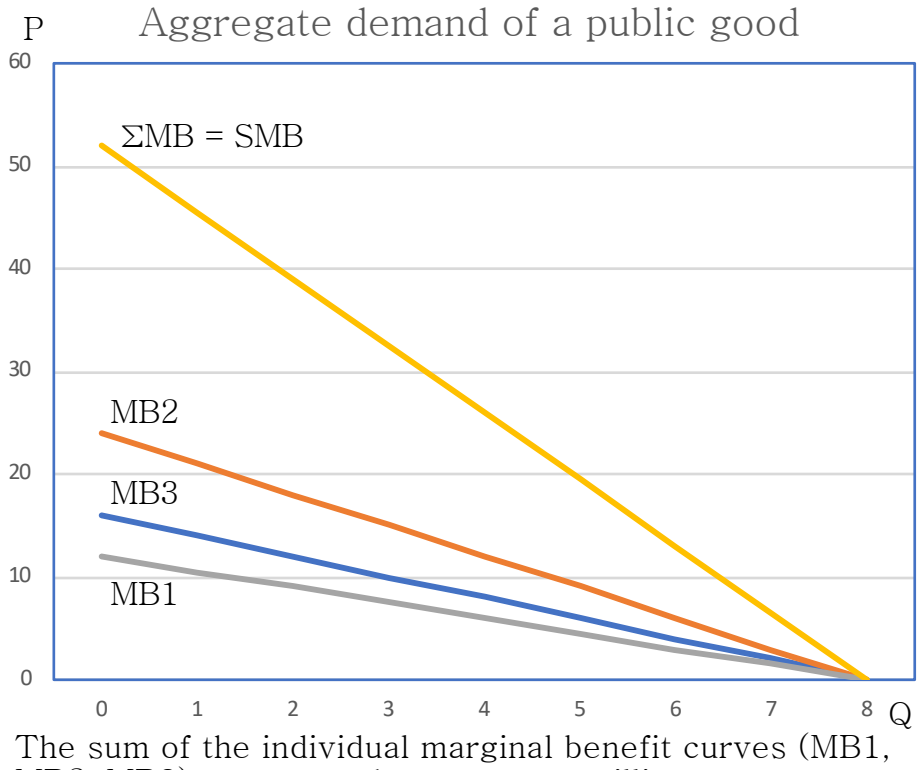
Real-world aspects – An example of a pure public good is national defense. It is non-excludable because America's defense establishment offers protection to everyone in the country. Conversely, items on sale in a store, such as gloves, are excludable because the store can prevent an individual from obtaining the good unless there is payment. Defense is also non-rivalrous because one individual's protection does not prevent another person from receiving protection. On the other hand, gloves are rivalrous. Only one individual can wear a pair of gloves at a time.

Source: https://www.econlib.org/library/Enc/PublicGoods.html

Graphical –

Is the Good Exclusive? \ Is the Good Rivalrous?	Yes	No
Yes	Private Goods (clothing, cookies, cars)	Club Goods (theaters, private parks)
No	Common Pool Goods (timber, coal, oil)	Pure Public Goods (air, national defense)

Four Types of Goods: Categories of goods in economics, based on the characteristics of excludability and rivalry. Note however, these characteristics have varying degrees, a good can be partially rival or somewhat excludable, so not every good or service fits perfectly into a category.



The sum of the individual marginal benefit curves (MB1, MB2, MB3) represent the aggregate willingness to pay or social marginal benefit.

Practice questions

1. Give an example of a private good, club good, common good, and public good. For each example explain why that good is rivalrous, exclusive, neither, or both.
2. The tables illustrate the demand for hot chocolate from individuals A and B. Provide the aggregate demand or social marginal benefit of the individuals assuming that hot chocolate is a private good

P($)	Q
2	10
3.5	7
5	3.5
7	2

P($)	Q
2	6
3.5	4
5	3
7	1

P($)	Q

3. Jack and Jill's demand for good A is given by the functions $Q = 20 - 2P$ & $Q = 10 - P$ respectively. If A is a private good what is the equation for the social marginal benefit of the consumption of good A?
4. Now suppose that good A is a public good. Write down the equation for the marginal social benefit of good A consumption. Why will this answer be different than the answer to Question 3?

Numerical solutions: **2.** P: \$2, \$3.50, \$5, \$7 Q: 16, 11, 6.5, 3; **3.** P = 10-Q/3; 4. P = 20-1.5Q.