

Public Goods Example and Problem¹ Instructional Primer²

Public goods share traits uniquely different than those of private goods. To begin with public goods are the byproduct of a market failure, typically arising from a collective action problem. For example, many in society want to enjoy the good, such as a road, bridge, or park, but few are interested in paying for it. Were private producers to provide the product the public's demand may not be fully realized through the collection of revenues and the producer's efforts may fail. Additionally, a public good is often deemed to be "good" for society by societal leaders, but may not be something that member of society are prepared or able to pay for through a usual system of providing and charging for the good. As such, most public goods are funded largely if not entirely through public coffers funded through the receipt of taxes.

Public goods have two characteristics that set them apart from private goods: they are non-rival and non-excludable. By this we mean that one person's use of the good does not exclude another from also using and enjoying it (non-excludable) and as such consumers have no motivation to compete for the good (non-rival).

Whereas the price for a private good purchased by one consumer is typically equal to the price any consumer might be required to pay for the good, the price for a public good is the sum of the prices consumers are required to pay for the good (typically the result of the collection of taxes) and we consider this price to be equal to the marginal cost of providing the good. That marginal cost is equal to price is a function of the provider of the good, usually a government or public agency, has little or no profit motive.

Additionally, the quantity producer of a private good is the sum of the quantities of the good consumers will purchase and use, whereas the quantity produced of a public good is fixed at a level such that all consumers in the subject public are able to consume or enjoy the good without their consumption of the good becoming rival and excludable.

Think about a public park in a particular municipality. Just because one family chooses to use the park, it isn't likely that it precludes others from doing so – consumption or use of the park is non-rival and non-excludable. The price the public pays for the use of the park is equal to the taxes and fees collected by the municipality from all local households since it is likely that the municipality runs a balanced budget, the sum of the price paid is equal to the cost of providing the park.

¹ This primer is intended to present an abbreviated discussion of the included economic concepts and is not intended to be a full or complete representation of them or the underlying economic foundations from which they are built.

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To understand how we might calculate the optimal quantity and price(s) for a public good consider the following example:

A three agent economy (Eric, Kristen, Jon) with one public good (Q), with MC=6, where each agent has their own unique demand good for Q. What should each agent be expected to pay for the amount of Q each uses (this is dependent on their individual demands for Q)

Eric Demand^{Eric}: $Q^E = 120 - 30 P^E$
 Kristen Demand^{Kristen}: $Q^K = 110 - 22 P^K$
 Jon Demand^{Jon}: $Q^J = 140 - 20 P^J$

Since this is a public good, there is only one particular quantity level of it so $Q^E = Q^K = Q^J = Q$, and $P = P^E + P^K + P^J$ Remember that for a public good we sum the price each agent is prepared to pay for the good based on their demand schedules.

To solve this system we rewrite the equations normalized by Q as follows

$$\begin{aligned} Q^E = 120 - 30 P^E &\longrightarrow P^E = 4 - Q/30 \\ Q^K = 110 - 22 P^K &\longrightarrow P^K = 5 - Q/22 \\ Q^J = 140 - 20 P^J &\longrightarrow P^J = 7 - Q/20 \end{aligned}$$

Now sum the equations – add the three equations to each other being careful to keep the left hand variables to the left of the equation and the right hand to the right:

$$\begin{aligned} P^E + P^K + P^J &= 4 - Q/30 + 5 - Q/22 + 7 - Q/20 \\ P &= 16 - Q(1/30 + 1/22 + 1/20) \\ P &= 16 - Q(.033 + .045 + .05) \\ P &= 16 - .128Q \end{aligned}$$

Then set $P = MC$ from above such that

$$\begin{aligned} 6 &= 16 - .128Q \text{ and solve for } Q \\ -10 &= -.128Q \\ Q &= .128/10 \\ Q &= 78.125 \end{aligned}$$

Now plug this value of $Q = 78.125$ into each demand equation to obtain the value each agent will pay for their usage of Q

$$\begin{array}{lll} P^E = 4 - Q/30 & P^K = 5 - Q/22 & P^J = 7 - Q/20 \\ = 4 - 78.125/30 & = 5 - 78.125/22 & = 7 - 78.125/20 \\ = 1.396 & = 1.448 & = 3.097 \end{array}$$

Confirm that this is right value for P by summing $P^E + P^K + P^J = MC = 6$

$$1.396 + 1.448 + 3.097 = 5.94 \text{ (appx 6 exclusive of rounding errors)}$$

Public Good Problem: Robinson and Friday

Consider a society inclusive of two agents, Robinson and Friday, in which there is one public good: a banana tree. We know the tree is a public good because it produces more bananas than the agents can consume and there is never shortage of bananas, but it does require some pruning and care to produce the quality of banana the agents enjoy. Let's assume that there is no currency in this society and that the price each agent might have to pay is some unit(s) of labor, which we'll call P^i and that the preferred/optimal quantity of bananas is Q^* . We take as given that the marginal cost of a banana in this society is equal to 10 ($MC=10$).

The following represent each agent's demand for bananas:

Robinson	Demand ^{Robinson} : $Q^R = 200 - 15 P^R$
Friday	Demand ^{Friday} : $Q^F = 150 - 35 P^F$

With this information, answer the following questions:

- What is the optimal quantity (Q) of bananas in this society?
- How much are Robinson and Friday each prepared to pay to consume bananas?
- What is the total price this society is prepared to pay to consume bananas?
- What does this tell us about the Robinson and Friday's relative preferences in respect to the consumption of bananas?
- What would you have to say about the quantity that Robinson and Friday each appear to prefer to consume? Is there anything about this consumption that seems slightly odd?