**Introduction**

The city of Nairobi, Kenya, has a garbage problem. Every few days, residents of the various Nairobi neighborhoods bring their trash to large dumpsters in central areas or smaller dumpsters along their local streets. In theory, city council employees then collect the garbage and cart it off for disposal. In practice, however, those employees often fail to show up, leaving the garbage to rot in the streets and residents to fume in frustration. An economist might wonder why the residents of Nairobi don’t simply scrap the current system of public trash collection and instead pay a private service to pick up their trash. In this way, the free market might solve Nairobi’s problems. The trouble is that private trash collection, financed by a voluntary fee paid by neighborhood residents, faces the classic *free rider problem*: any resident could continue to throw his trash in the dumpsters, and then refuse to pay his share of the trash collection fee, with the hope that his neighbors would pick up the costs for him. If his neighbors cover the cost of collection, this free rider gets all the benefits of trash collection but pays none of the costs. Yet, if some in the neighborhood free ride, others will feel exploited by paying to have their non paying neighbors’ trash picked up; these residents might decide not to pay either. Eventually, the number of free riders might grow large enough that the town would not be able to raise sufficient funds to finance the trash collection from a private company. For this reason, very few neighborhoods have been able to replace the city council trash collection with private collection financed by voluntary trash collection fees. The problems faced by the city of Nairobi illustrate the difficulties of effectively addressing the free rider problem through a private mechanism. Goods that suffer from this free rider problem are known in economics as *public goods,* and they are the focus of this chapter. We begin by defining *public goods* and determining the optimal level of their provision. We then turn to the first question of public finance and ask if the government should be involved in the provision of public goods. We show that the private sector is in fact likely to under-provide public goods due to the free rider problem. Sometimes, however, private actors successfully provide public goods, so we discuss the factors that make private provision successful. We then discuss the public provision of public goods. In principle, the government can simply compute the optimal amount of a public good to provide, and provide that level. In practice, however, the government faces several difficulties in providing the optimal level of public goods. First, when private parties are already providing the public good, government provision may simply *crowd out* this private provision so that the total amount of the public good provided does not rise. Second, measuring the actual costs and benefits of public goods (which is required for determining optimal public goods provision) is difficult. Finally, determining the public’s true preferences for public goods, and aggregating those preferences into an overall decision on whether to pursue public goods projects, raises a variety of challenges.

**Optimal Provision of Public Goods**

Goods that are **pure public goods** are characterized by two traits. First, they are **non-rival in consumption:** that is, my consuming or making use of the good does not in any way affect your opportunity to consume the good. Second, they are **non-excludable:** even if I want to deny you the opportunity to consume or access the public good, there is no way I can do so. These are fairly strong conditions, and very few goods meet these conditions in practice. Most of the goods we think of as public goods are really **impure** **public goods,** which satisfy these two conditions to some extent, but not fully.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Is the good rival in consumption? | | |
| Is the good excludable? |  | YES | NO |
| YES | Private good (ice cream) | Impure public good (Pay TV) |
| NO | Impure public good  No (crowded city pavements) | Pure public good (national defense) |

The table above shows possible combinations of public good characteristics. Goods that are both excludable and rival are pure private goods. Private goods such as ice cream are completely rival (once you eat an ice cream cone, I cannot consume that ice cream cone at all) and they are completely excludable (you can simply refuse to sell me an ice cream cone). There are two types of impure public goods. Some goods are *excludable, but* *not rival*. The best example here is cable television: the use of cable TV by others in no way diminishes your enjoyment of cable, so consumption is non - rival. It is, however, possible to exclude you from consuming cable TV: the cable company can simply refuse to hook you up to the system. Other goods, such as walking on a crowded city sidewalk, are *rival but not excludable*. When you walk on a crowded city sidewalk, you reduce the enjoyment of that walking experience for other pedestrians, who must now fight against even more foot traffic. Yet it would be very difficult for any city to exclude individuals from using the sidewalk! Pure public goods are rare because there are few goods that are both not excludable and not rival. A classic example of a pure public good is national defense. National defense is not rival because if I build a house next to yours, my action in no way diminishes your national defense protection. National defense is not excludable because once an area is protected by national defense, everyone in the area is protected: there is no way the government can effectively deny me protection since my house is in a neighborhood with many other houses. Other classic examples of pure public goods include lighthouses and fireworks displays. It is helpful to think about a public good as one with a large positive externality. If I set off fireworks high into the sky, it benefits many more people beyond myself, because many people will be able to see the display. I am not compensated for other people’s enjoyment, however: I can’t exclude others from seeing the fireworks, so I can’t charge them for their enjoyment.

**Optimal Provision of Private Goods**

Before we model how to determine the optimal quantity of public goods to provide, let’s review the conditions for optimal provision of private goods. Imagine that there are two individuals, Ben and Jerry, who are deciding between consuming cookies and ice cream, two pure private goods. For simplicity, suppose that the price of cookies is Ksh. 1.

**(INSERT FIGURE 1 HERE)**

The Figure 1 above shows the analysis of the market for ice cream cones. Panels (a) and (b) show Ben’s and Jerry’s individual demand curves for ice cream cones; that is, the number of ice cream cones that each man would demand at each price. Panel (c) shows the market demand curve, the horizontal sum of the two individual demands: for every price of ice cream cones, we compute Ben’s demand and Jerry’s demand, and then add them to produce a total market demand. At Ksh.2, Ben would like two ice cream cones, and Jerry would like one, for a total market demand of three cones. As we learned in microeconomics, the demand curve in the final panel of figure 1 above also represents the *social marginal* *benefit (SMB)* of ice cream consumption, that is, the value to society from the consumption of that cone. The market supply curve for ice cream represents the marginal cost of producing ice cream cones for a firm. In a market with no failures, this curve also represents the *social marginal cost (SMC)* of ice cream production, the cost to society from the production of that cone. In a private market, then, equilibrium occurs where *SMB* =*SMC,* the point at which supply and demand intersect. In Figure above, equilibrium is at point *E:* at a price of Ksh.2, the market demands three ice cream cones, which are supplied by the firm. A key feature of the private market equilibrium is that *consumers demand different* *quantities of the good at the same market price*. Ben and Jerry have different tastes for ice cream, relative to cookies. The market respects those different tastes by adding up the demands and meeting them with an aggregate supply. In this way, Ben and Jerry can consume according to their tastes. Since Ben likes ice cream more than Jerry, he gets two of the three cones that are produced.

**Optimal Provision of Public Goods**

Now, imagine that Ben and Jerry are choosing not between ice cream cones and cookies but between missiles (a public good) and cookies. Once again, the price of cookies is set equal to Ksh.1. A difference between missiles and ice cream cones is that individuals cannot tailor their own specific consumption of missiles. Because missiles are a public good, whatever amount is provided must be consumed equally by all. This characteristic of the market for public goods turns the private market analysis on its head, as shown in Figure 2. Each person is now forced to choose a common quantity of the public good. Because Ben and Jerry have different tastes for missiles and cookies, they will be willing to pay different prices for this common quantity. Ben has a very flat demand for missiles; he is willing to pay only Ksh.2 for the first missile and Ksh.1 for the fifth missile (panel (a)). Jerry has a steeper demand, and is willing to pay Ksh.4 for the first missile and Ksh.2 for the fifth missile (panel (b)).

**(INSERT FIGURE 2 HERE)**

Whatever number of missiles is chosen applies to Ben and Jerry equally, since missiles are a public good. To arrive at the market demand for missiles, we do not sum horizontally, as with private goods (where we sum the individual quantities demanded at the given market price). Instead, we sum *vertically* by adding the prices that each individual is willing to pay for the fixed market quantity. Ben and Jerry are together willing to pay Ksh.6 for the first missile, but their willingness to pay declines as the number of missiles increases, so they are only willing to pay Ksh.3 for the fifth missile. This vertically summed demand curve is shown in panel (c) of Figure 2. Panel (c) also shows a supply curve for missiles, which equals their marginal cost of production. The socially optimal level of production is the intersection of this supply with the vertically summed demand. That is, given that any missiles that are provided protect both Ben and Jerry, the producer should consider the *sum* of their valuations (their willingness to pay) in making its production decision. The resulting socially optimal level of production is five missiles.

**Private Provision of Public Goods**

We have now developed the conditions for the optimal provision of public goods: public goods should be produced until the marginal cost for producers equals the sum of the marginal rates of substitution for all consumers. With this finding in mind, the first question to ask (as always) is: Does the private sector get it right? If the private sector provides the optimal quantity of goods at the market price, then there is no market failure, and there is no potential role for the government in terms of improving efficiency.

**Private -Sector Under provision**

In general, the private sector in fact *under provides public goods* because of the **free rider problem**: since my enjoyment of public goods is not solely dependent on my contribution to them, I will contribute less to their provision than is socially optimal. Let’s consider this problem in the context of an example. Suppose Ben and Jerry live by themselves far away from others. It is June 1st, and they want to have a celebration. For this celebration, they care about only two consumption goods: ice cream cones and fireworks. The price of each of these goods is Ksh.1, so for every firework they buy; they forgo a serving of ice cream. Ice cream is a private good here, but fireworks are a pure public good: fireworks are non - rival since both Ben and Jerry can enjoy them without impinging on the other’s enjoyment, and fireworks are non -excludable since they explode high in the sky for both Ben and Jerry to see. Neither Ben nor Jerry cares about who sends up the firework, as long as it’s up in the sky for them to see. Both Ben and Jerry benefit equally from a firework sent up by either of them; what matters to them is the *total amount of fireworks*. To further simplify the example, suppose that Ben and Jerry have identical preferences over different combinations of fireworks and ice cream. If left to their own devices, Ben and Jerry will choose to consume combinations of fireworks and ice cream cones identified by the points at which their indifference curves are tangent to their budget constraints. The slope of the budget constraints is 1, since fireworks and ice cream cones are each Ksh.1 per unit. The slope of the indifference curves is the *MRS,* or the ratio of marginal utilities. So both Ben and Jerry will set their marginal utility as *MUF*/*MUic* =1, or *MUic = MUF*. This equivalence will determine the quantities of fireworks and ice cream cones consumed.

The optimality condition for public goods is that the marginal cost of the good should be set equal to the *sum* of marginal rates of substitution. Optimal consumption of fireworks would therefore occur at the point at which

*MUBF*/*MUBic* x *MUJF*/*MUJic* =1.

Since Ben and Jerry’s preferences are identical, this is equivalent to saying that 2 x (*MUF* / *MUic*) = 1, or *MUF* = ½ x *MUic*. Recall that marginal utilities diminish with increasing consumption of a good. In private market equilibrium, fireworks are consumed until their marginal utility equals the marginal utility of ice cream (since the prices of both goods are Ksh.1). But the optimality calculation shows that fireworks should be consumed until their marginal utility is *half* the marginal utility of ice cream; that is, more fireworks are consumed in the optimal public goods outcome than in the private outcome. This result is exactly what we would expect from the free rider problem. Ben and Jerry each have to forgo a serving of ice cream to provide a firework, but both Ben and Jerry benefit from each firework that is provided. There is a clear strong positive externality here: Ben’s or Jerry’s provision of the firework greatly benefits the other person. As we saw with positive externalities earlier, this situation leads naturally to underproduction. Thus, the free rider problem leads to a potential role for government intervention.

EXAMPLES: FREE RIDER PROBLEM

1. A 2005 study of the file -sharing software Gnutella showed that 85% of users download files only from others, and never contribute their own files via upload. The top 1% of Gnutella users contribute 50% of the total files shared, and the top 25% of users provide 98% of all files traded. The file -sharing software Kazaa now assigns users ratings based on their ratio of uploads to downloads and then gives download priority to users according to their ratings, thus discouraging free riders.
2. In 1994, the town of Cambridge, England, tried to provide a public good in the form of 350 free green bicycles scattered throughout the city. Users were expected to return each bicycle to one of 15 stands after its use. Unfortunately, within four days of the scheme’s launch, not a single bicycle could be found, most having been likely stolen and repainted a different color. The scheme ultimately cost the city about $20,000, thus posing the ultimate in literal “free rider” problems.

Questions

1. We add the demands of *private* goods horizontally but add the demands of *public* goods vertically when determining the associated marginal benefit to society. Why do we do this and why are the procedures different for public and private goods?
2. The residents of Nyahururu used to pave 20 miles of road ways per year. After the government of Nyahururu began paving 10 miles of roadways per year itself, the citizens cut back their paving to 3 miles per year, for a total number of roadway miles paved per year of 13 miles. What might be happening here?
3. Bill’s demand for hamburgers (a private good) is

*Q* = 20-2*P* and Ted’s demand is *Q* = 10-*P*.

**a.** Write down an equation for the social marginal benefit of the consumption of hamburger consumption.

**b.** Now suppose that hamburgers are a *public* good. Write down an equation for the socialmarginal benefit of hamburger consumption.

*4.* People in my neighborhood pay annual dues to aneighborhood association. This association refundsneighborhood dues to selected home owners whodo a particularly nice job in beautifying their yards.

**a.** Why might the neighborhood association provide this refund?

b. At the most recent home owners’ association meeting, home owners voted to end this practice because they felt that it was unfair that some people would not have to pay their share of the costs of maintaining the neighborhood. What is likely to happen to the overall level of neighborhood beautification? Explain.

5. Zorroland has a large number of people who are alike in every way. Boppoland has the same number of people as Zorroland, with the same average income as Zorroland, but the distribution of incomes is wider. Why might Boppoland have a higher level of public good provision than Zorro land?

**6.** Think about the rival and excludable properties of public goods. To what degree is *radio broadcasting* a public good? To what degree is a *highway* a public good?

**7.** Think of an example of a free rider problem in your hometown. Can you think of a way for your local government to overcome this problem?

**8.** In order to determine the right amount of public good to provide, the government of Kenya decides to survey its residents about how much they value the good. It will then finance the public good provision by taxes on residents. Describe a tax system that would lead residents to under report their valuations. Describe an alternative system that could lead residents to over report their valuations.