Microeconomics with Ethics

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Chapter 23
Market Imperfections: Common Resources

This chapter introduces another type of situation similar to public goods in which a product is not both rival and excludable in consumption as is a purely private good. Here we introduce common resources which have the feature of being non-excludable and rival in consumption. In other words, common resources have one of the characteristics of a public good (non-excludability) but not the other (rivalry).

Common resources are not a final product sold in a market, but rather an input used in a production process. The resources are labeled common to indicate that the resource is easily accessed and available for anyone to freely use. It is another way of saying non-excludable. Because common resources are non-excludable in consumption, they violate an assumption of perfect competition and thus represents an example of a market imperfection. In general, because market imperfections create potential inefficiencies there is a possibility for government intervention to improve the market outcome.

In this chapter we will use a specific constructed example of ranching versus farming to demonstrate some of the problems that can arise when a common resource exists and how government intervention can improve the market outcome. We will also discuss some of the ideas of the first female Noble prize winner in economics, Elinor Ostrom, who studied the way in which private parties sometimes can form collective action organizations that can solve some of the problems caused by common resources. These ideas offer non-governmental solutions that could be viable in some circumstances.

23.1 Common Resources

Learning Objectives

1. Learn the characteristics of common resources and several notable examples of them.
2. Learn the problem known as the tragedy of the commons

Common resources are inputs into a production process that have the feature of being non-excludable and rival in consumption. One example of a common resource is an ocean fishery. An ocean fishery describes the total area in the world's oceans where certain species of fish, such as tuna or pollack, can be harvested. Because the ocean fishery where, say tuna, can be fished, is a huge area, any fisherman with an appropriately fitted boat can freely enter the fishery and harvest tuna. Because the area where tuna can be caught is so vast, there is no inexpensive method to monitor entry to the area by fishing vessels. For this reason the resource is available for common use by anyone who wishes to access it. Access to the tuna fishing grounds is non-excludable.

However, once a fishing vessel catches tuna and brings it to the market to sell, that tuna becomes a private good whose consumption by one person prevents another from using the same tuna simultaneously. For this reason we characterize the fishery resource as rival in consumption.

The key problem that arises with a common resource is over-usage. Although fish populations are a renewable resource, given that fish continually create offspring, excessive fishing of a particular species could undermine the reproductive process leading to a decline in the fish population. If tuna fisherman over-fish an area, the future tuna catch could fall substantially, even to zero. This is a bad outcome for the fishermen, the fish consumers, and also for the fish, which in the extreme could result in extinction of the species. This is not an uncommon event in history where human harvest of a species has led to the extinction of the dodo bird, the passenger pigeon, the woolly mammoth and other large megafauna in earlier prehistoric times. Because such dire consequences are not rare, they have been given the moniker, the tragedy of the commons.

Other classic examples of common resources include open pastureland and river water used for irrigation. The case of pastureland refers more to an earlier time when vast amounts of unowned land was freely accessible to anyone wishing to use it. In more recent times much land has been privatized and fenced which makes the resource excluded from common usage. Thus, much like toll roads, pastureland can be a private good if access is restricted using barriers to entry. However, if the barriers are not there, the resources become non-excluded and therefore common. Use of river water for irrigation is generally non-excludable because anyone along the long expanse of a river can tap into it to irrigate their farm fields. However, if too many farmers upstream withdraw water from the river, there may be very little left downstream for other farmers. For this reason, river water is rival in consumption. A good example of over-irrigation leading to a tragedy of the commons is the cotton farmer irrigation of the Darya river resulting in the near disappearance of the Aral Sea in Russia.

A Simple Model of Common Resource Usage

We can better understand the problems that arise with common resources by constructing a simple example. Imagine a small rural community where there are only two occupations possible, a cattle rancher or a farmer. Suppose there are 20 individuals living in this community and each must choose an occupation. We'll imagine that everyone is motivated to maximize their own income obtained via one of the occupations. Let income be determined according to the schedule shown in Table 23.1.

Assume that ranching involves use of the common resource, open pastureland. As a result, as more and more ranchers use the pasture to feed and fatten their cattle, depletion of the grass resource results in diminished output per rancher and therefore lower income. It makes sense that as more herds of cattle graze the land, there will be less grass for each cow to eat and therefore each cow will not grow as fat. Lower weight results in lower income when the cattle is sold. Because the pasture is shared, one rancher's usage of it has a negative external effect upon the other ranchers.

Rancher income depends upon how many ranchers are in the industry, with larger numbers resulting in lower per rancher income. The first column in Table 23.1 shows various numbers of individuals who might choose ranching, while column 2 shows the associated income per rancher. Notice that rancher income falls by $5 for each additional rancher according to the formula, I = 50 – 5n, where I is income in dollars and n is the number of ranchers.

Table 23.1 Rancher and Farmer Income Schedule

# of Ranchers (n)	Per Rancher Income (I = 50 – 5n)	Per Farmer income
1	45	10
2	40	10
3	35	10
4	30	10
5	25	10
6	20	10
7	15	10
8	**10**	**10**
9	5	10

In contrast, farmers are allocated their own land to farm for themselves. There is no common resource in farming. Consequently and to keep the model simple, farming income is assumed fixed at $10 per farmer regardless of how many farmers there are, as indicated in the third column of Table 23.1.

We can find the free market solution to this model by conducting the following thought experiment. Suppose at first everyone is assigned to be a farmer and each would earn $10. But, we can ask if one person, given the opportunity, would switch to become a rancher? The answer is yes because at n = 1, rancher income is $45 which is better than $10 in farming. Thus, income maximization implies that one person would enter ranching.

Next, we ask if a second person would enter ranching. Again the answer is yes because at n = 2, rancher income is $40 which is greater than $10. This process should continue as long as rancher income exceeds, or is equal to, farmer income. According to Table 23.1 , that process ends when there are 8 ranchers. At n = 8, ranching income becomes $10 per rancher which equals farmer income. At this point an income maximizing person would be indifferent between ranching and farming and there would be no incentive to adjust workers any further. We can call n = 8 ranchers (and 12 farmers) the equilibrium allocation of labor in this model.

Next we can ask whether this equilibrium is the most efficient outcome possible in this model. To answer this we present the community income schedule in Table 23.2. Column 2 shows rancher income at each level of rancher participation. To calculate, take rancher income from Table 23.1 and multiply by the number of ranchers. Thus, at n = 4 for example, per rancher income is $30, therefore total rancher income is 4 x 30 = $120. For all total ranchers, farmer income is $10 per farmer and so total farmer income is (20-n)10 which equals $160 at n =4.

Total community income is the sum of rancher and farmer income and is shown in the fourth column.

Table 23.2 Community Income Schedule

# of Ranchers (n)	Total Rancher Income (TR = RI * n)	Total Farmer Income (TF = FI*(20-n))	Total Income (TI = TR + TF)
1	45	190	235
2	80	180	260
3	105	170	275
4	**120**	**160**	**280**
5	125	150	275
6	120	140	260
7	105	130	235
8	80	120	200
9	45	110	155

Notice that community income is highest ($280) when there are four ranchers at n = 4 (the row in bolded type). That means that the optimal community outcome, that is the highest level of economic efficiency, is achieved at a smaller number of ranchers than would naturally come about in a free market. This means that the free market outcome, of n = 8, represents excessive rancher output relative to what is socially optimal (n = 4).

In essence, free market ranchers only consider the effect that entering ranching has on their own income while ignoring the wider impact of overgrazing. Consider again sequential entry of ranchers starting at n = 4. The fifth rancher is individually inclined to enter because he will get $25 of income which is $15 more than his income as a farmer. However, his entry will reduce the incumbent ranchers income by a total of $20 (= 4 x 5). This is the negative external effect caused by rancher entry. Altogether, the net effect of his entry as the fifth rancher is minus $5.

A government that is aware of this issue could regulate the market to achieve the social optimal. One option is a restriction on the number of ranchers allowed to use the common resource, pastureland. By regulating ranching and restricting access to only 4 four ranchers, the government will achieve the social outcome. However, one unfortunate implication is that income will become unequal as the four lucky ranchers will see their income rise to $30 each, three times more than farmer income.

This situation also opens the door for corruption within the government regulatory agency. Knowing that monopoly-like rents will be earned by ranchers, will inspire lobbying pressure to allocate the ranching rights. Government officials could allocate them to their own friends, family and political supporters, thereby guaranteeing a kick-back in the form of campaign contributions or votes.

An alternative policy response would be to reduce the incentives to ranch by taxing ranching. In this example, a tax of $20 per rancher would be sufficient to reduce the number of ranchers to four. To see why note that the fourth rancher would just be willing to enter the industry despite a $20 tax. That's because the fourth rancher would earn $30 extra from ranching but be forced to pay $20 in taxes leaving him with $10, equivalent to what he would earn in farming. Thus, the fourth entrant would be indifferent between entering or not. So let's assume he does enter.

Consider next a fifth rancher. The fifth rancher would earn $25 to enter, $15 more than farming income. After the tax of $20, this farmer would lose $5 meaning he has no incentive to enter the industry. This proves that a $20 tax would limit the number of ranchers to the socially optimal level of 4.

The tax has another beneficial outcome. By using a tax, the government maintains income equality. In this equilibrium all farmers and ranchers net $10 in income. With the extra $80 in government revenue (4 x 20), the government can purchase public goods that will benefit everyone in the community.

This is one of the gleaning examples of beneficial government intervention, because the rancher tax maintains the income of all community members while raising $80 in revenue to spend on public goods. This money comes from the improvement in economic efficiency achieved by limiting the exploitation of the common resource by profit seeking private ranchers. At worst, no one loses from this policy and most likely everyone benefits as long as the public good is something like national defense which benefits everyone.

However, the government tax policy has one other potential benefit. We mentioned earlier that overexploitation of a common resource can lead to the Tragedy of the Commons problem. A tragedy occurs when the common resource becomes so overused that it becomes unsustainable. For a renewable resource like ocean fisheries this would mean that the fish species being harvested faces extinction.

Suppose in the rancher example above, that the common pastureland becomes unsustainable at the level of 6 ranchers. Six or more ranchers would lead to desertification, let's say, and would never be able to be used for grazing in the future. (the red rows in Table 23.2). Fewer than 6 ranchers and the pastureland will continue to renew itself for future use (the rows in black type).

This means, under the assumptions of this constructed example, the free market outcome of 8 ranchers would eventually lead to the complete destruction of the common pastureland. Eight ranchers makes the pastureland an unsustainable resource and creates the tragedy of the commons problem. However, with a government tax of $20 per rancher, the government not only raises national welfare and benefits everyone, they also prevent the tragedy of the commons from occurring in pasture resources. This is a clear win-win-win situation for everyone involved.

Results like this demonstrate how government intervention in the presence of a market imperfection can improve economic efficiency. However, these results are assured only if the assumptions of the model are valid. If the assumptions are not totally valid, for example if the government does not have perfect information, or if lobbying by special interests affects the policy choice, then these same results might not arise. In the next section we'll consider some alternative solutions to this problem that would not require the government to intervene.

Key Takeaways

1. Common resources are inputs into a production process that have the feature of being non-excludable and rival in consumption
2. Free market access to a common resource by income maximizing firms will lead to overuse relative to the social optimum

3. Government can achieve the social optimum either by regulation (a quota on the number of harvesters) or with a tax for usage of the common resource.
4. A government quota on common resource usage in the model increases income inequality
5. Optimal government policy in the presence of a common resource can lead to an improvement (or no loss) in welfare for all market participants and taxpayers.
6. A tragedy of the commons occurs when overuse of the common resource threatens the long-term sustainability of the resource
7. Optimal government policy can prevent the tragedy of the commons problem by reducing usage of the common resource to sustainable levels

23.2 Collective Action and Common Resource Management

Learning Objectives

1. Learn about the first female Nobel prize winner in economics and her research showing how non-governmental organizations can form to solve problems associated with common resources.

Elinor Ostrom was the first woman to receive a Noble Prize in Economics in 2009. During her career, Ostrom investigated numerous examples of common resource problems throughout history, from Alpine grazing in Switzerland to irrigation systems in Nepal and many others. By highlighting many historical examples, her work demonstrated that communities could organize themselves without government intervention to prevent tragedy of the commons outcomes from arising. One of her earliest examples showed rules dating to the 13th century concerning rights and responsibilities over common grazing land in Tobel, Switzerland.

However, collective actions such as these did not always arise spontaneously and many commons problems were not solved by their communities. Ostrom's work centered on understanding what conditions were necessary to generate the private community response.

The response that is needed is similar to government regulation but managed by the community themselves. For example, with respect to ocean fisheries, community rules might limit how frequently a fisherman is allowed to fish in the nearby waters, or might limit the size of their catch over some period of time. However, setting a rule is not enough. An organization also needs to monitor the situation for compliance and devise methods of punishment for individuals that break the rules.

As Mancur Olson argued, collective action is easier to implement when the group to be organized is smaller rather than larger (see Chapter 21). That means with respect to the fisherman example, a small community of fishers, all who embark on their expeditions and return with their catch to a small number of ports would be easier to collectively organize than say whaler fishing boats fishing the worlds entire oceans from ports all over the world. A small community would know all the users of the resource and could more easily monitor compliance and impose penalties for violators. This is one of many factors highlighted by Ostrom that influences whether the commons problem can be solved without government involvement.

There is one other problem with the government solution worth mentioning. In the previous section we demonstrated how government could regulate common resources and improve economic efficiency. However, that outcome depends on the government having the correct information needed to determine the optimal policy. Sometimes governments try to impose their policies on communities who do not accept the government information as correct. Economists call these information asymmetries, because the beliefs of different market participants differ. In other words, community info may differ from the info the government has. If the government has inaccurate information, or if they are not familiar with the customs and practices of certain communities, they might regulate in ways that causes more harm than good. This is a common source of friction between communities and government regulators across many areas and issues.

Elinor Ostom once wrote, "There is no reason to believe that bureaucrats and politicians, no matter how well meaning, are better at solving problems than the people on the spot, who have the strongest incentive to get the solution right." This is an argument supporting local collective action as opposed to intervention by government and is based on the presumption that local info is more accurate and that locals have a greater incentive to get it right. However, collective actions are much more difficult, if not impossible, to implement if the commons in question is worldwide in scope and the users include almost everyone. The example I'm thinking of is climate change.

To understand climate change as a problem of the commons we need only think of earth's atmosphere as being the common resource that everyone is using. What everyone is using it for is a place to dump their carbon dioxide. Everyone dumps their CO2 into a common pool whenever they drive their car, fly on an airplane, or use electricity. No one person contributes enough to make a difference, but when every one of 7 billion people use the resource simultaneously, it can cause a long term sustainability problem, just like the tragedy of the commons. In this case, local collective action is unable to solve the problem. But that's because the conditions needed to make collective action work effectively are not present.

In conclusion, common resource problems can be solved by both private collective actions and with government intervention. Successful intervention by either party requires good information about costs and benefits of various solutions. While there some reason to believe that local information is better than distant info, that may not always be the case. While there are some who argue that government must intervene to improve the commons, that too is not always the case.

Key Takeaways

1. Elinor Ostrom was he first woman to win the Nobel prize in economics in 2009
2. Ostrom's contribution was research showing conditions under which communities take collective action to solve common resource problems like the tragedy of the commons