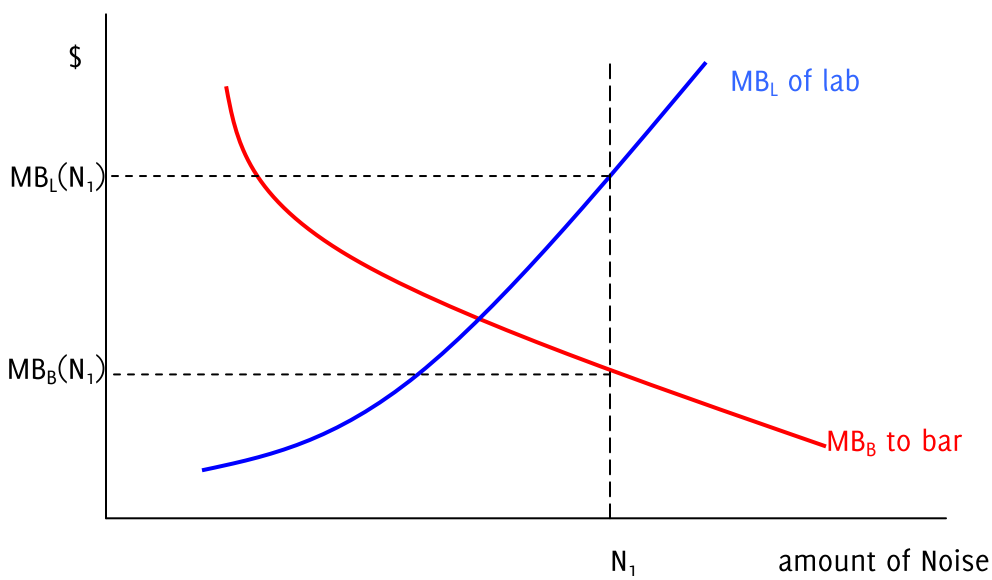
Lecture Notes 2
Economics of the Environment and Natural Resources/Economics of Sustainability
K Foster, CCNY, Spring 2011

Coase Theorem

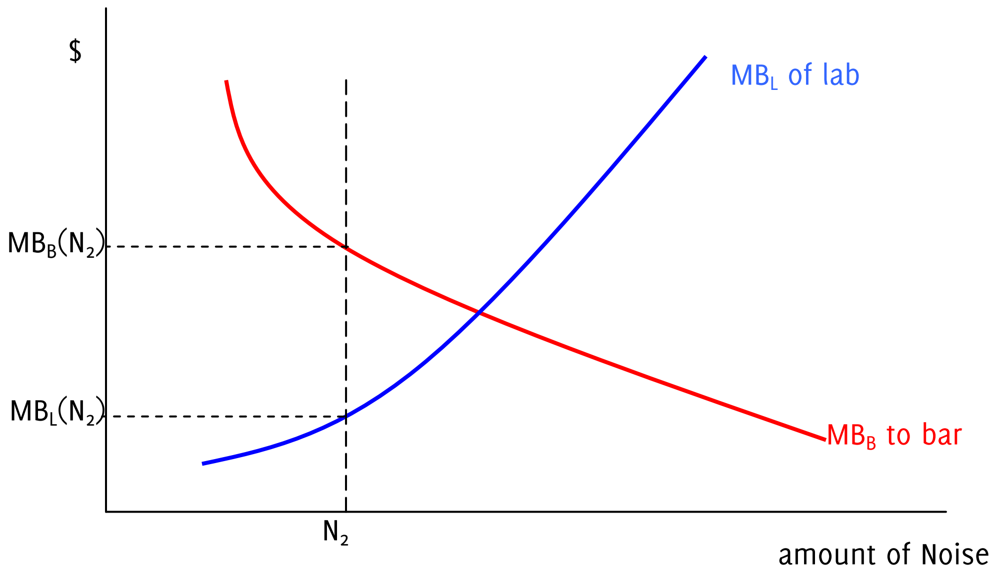
The Coase Theorem specifies why we link transactions costs with imperfect property rights: in the absence of transactions costs, many imperfections in property rights (many externalities) will be properly priced and so may be produced at Pareto optimal levels.

Consider the case of two neighbors sharing a building. One is a bar, which, in the course of ordinary business, produces loud music and loud people. The other is a laboratory which operates best without noise or vibrations; as these levels increase the lab must spend more money to shelter its experiments. Starting from zero noise, the bar gets a significant marginal benefit (MB) from the first few decibels of noise, however the marginal benefit falls as the level of noise rises. The lab can, with low cost, abate low levels of noise but its costs rise as it tries to abate more and more noise. Costs avoided are net benefits so we can consider this as a marginal benefit to the lack of noise: a small lack of noise has a small marginal benefit but as the noise rises the marginal benefit rises. So we can draw their respective marginal benefits (MB_L to the lab and MB_B to the bar) to different levels of noise (N):



Suppose that the level of noise were initially to be at some high level, N_1. Then the lab must be spending a large amount of money to abate the noise, $MB_L(N_1)$, while the bar gets a much lower marginal benefit from the noise, $MB_B(N_1)$.

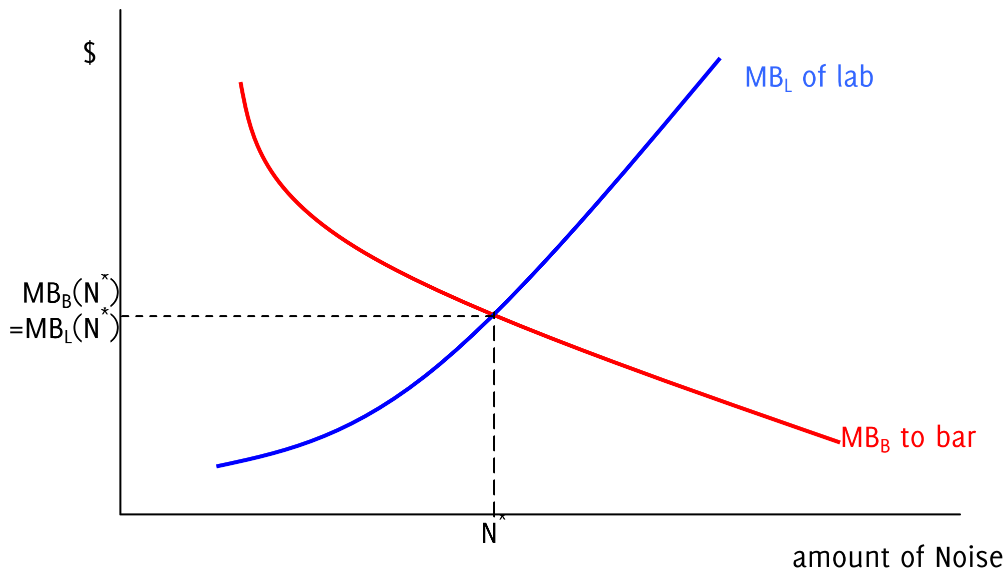
If, instead, there were a low level of noise, N_2, then the lab could abate it at low cost, $MB_L(N_2)$, while the bar would place a high marginal value ($MB_B(N_2)$, a high marginal profit) for making more noise.



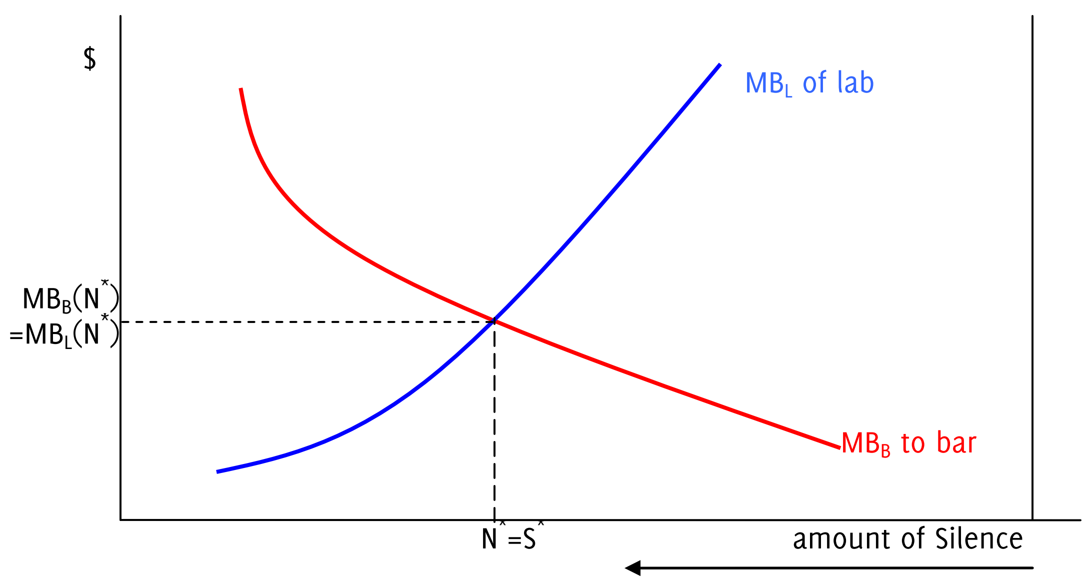
If there are clear property rights then the participants can trade. It may not matter if the law establishes that businesses have a right to silence or if the law establishes that businesses can make as much noise as they want – in either case the parties can then trade. If there is no clear law, either because there are no clear precedents or enforcement is capricious, then the two sides have an incentive to fight.

But suppose, for example, zoning laws mandate silence so that the lab has "ownership" of the lack of noise. In this case the lab can supply certain levels of noise by buying noise-reduction, so MB_L is a supply curve of noise. The bar would like to buy up the right to make a certain amount of noise, so MB_B is a demand curve. If we begin from cacophony, where the initial level of noise is at a high level such as N_1, then the lab would clearly want to lower the noise level: the last increment of noise could be sold at only a low price, $MB_B(N_1)$, but it costs the lab much more, $MB_L(N_1)$, to abate that noise. It will enforce a lower noise level. But not necessarily complete silence.

If, instead, the noise level were at a whisper, at an amount like N_2, then the bar would be willing to pay a large amount, MBB(N2), to be noisier, while the lab could abate that noise at a small cost, MBL(N2), so it would be profitable to sell the noise, buy the abatement technology, and make a profit from the difference. This will continue until the noise level reaches an equilibrium level, N*, where the marginal benefits to each side are balanced.



If, on the other hand, there were no restrictions on noise emissions, then the bar would have the right to emit as much noise as it chose. We can think of the bar as now supplying silence (the absence of noise, measured backwards on the horizontal axis) and the lab demanding silence. Since we're flipping the horizontal axis this gives a downward sloping demand (the MB_L) and upward sloping supply (MB_B).

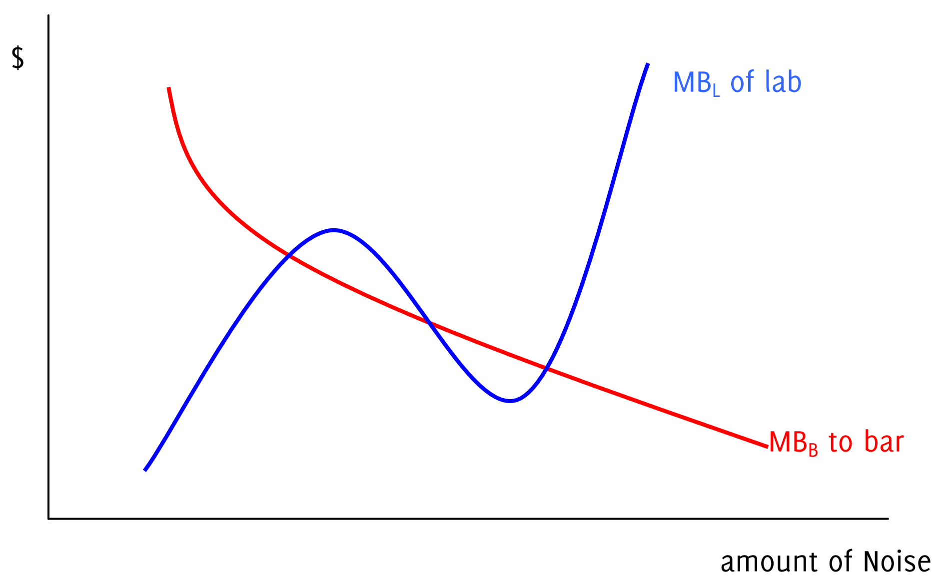


If the amount of noise were at cacophony N_1, then there would again be an incentive for trading: the bar could make a profit since it could reduce noise at only a small cost while the lab would be willing to pay a large amount for that reduced noise. If the noise were at a whisper, N2, then the bar would find it profitable to emit more noise, and the lab could not "outbid" it since the bar would demand a high price of $MB_B(N_2)$ while the lab would only be willing to pay $MB_L(N_2)$.

The big insight is that no matter whether the lab has a right to silence or if the bar has a right to noise, the final amount of noise is unchanged at N*. The initial allocation of property does not change the outcome. All that changes is the direction of money payments: if the lab has a right to silence then the bar will pay it for the amount N*; if the bar has a right to make noise then the lab will pay it. The direction of the flow of money changes but not the amount of noise chosen. This was the insight of Coase. He did not believe that zero transactions costs were universal or even common, but his insight clarifies how the problems of externalities might be solved by private transactions.

Note that this result depends on the absence of "income effects" which, while reasonable in the case of firms (without financing constraints) might not be as reasonable for consumers. If poor people must buy a lack of pollution then they might not have enough income.

This also assumes that both sides to the transaction have continuous and monotonic marginal benefit schedules. If either MB curve were not continuous, i.e. with jumps, then the price might not be fully determined – but the two sides should be able to bargain. If either MB curve were not monotonic then there could be multiple equilibrium points, such as this:

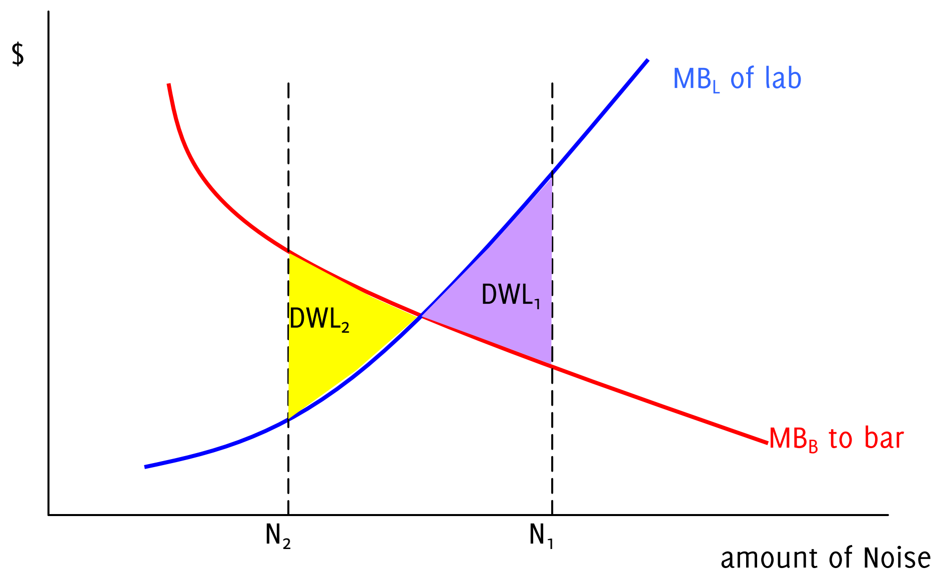


So there can be many complications but the central insight is that we should concentrate on transactions costs.

From the Coase viewpoint, transactions costs are equivalent to unclear (or insecure) property rights. What would happen if, in the above example of the lab and the bar, the noise were made by cars going by (ones tricked out with the bass speakers thumping, or Harley motorcycles with their distinctive roar)? The lab would have a difficult time either enforcing silence (if it had that right) or paying the passing vehicles (if they had a right to make noise). Similarly if there is one noisy bar annoying large numbers of adjacent apartment-dwellers then it would again be difficult either for the neighbors to get together to pay the bar to lower the noise (if the bar had the right to make noise) or for the bar to compensate them each.

In air pollution discussions, this is the difference between "point sources" and "non-point sources" since point sources of pollution (like large power plants) are easily identified while non-point sources (like every car) are much more difficult to effectively regulate.

With unclear property rights, if the noise level just happened to be at N_1 but there could not be trading, then there would be deadweight losses equivalent to the shaded triangle DWL_1; if the noise just happened to be at N_2 then without trade the deadweight losses would be the other shaded triangle, DWL_2.



If the government can assign property rights to one party or the other then there will no longer be deadweight losses – i.e. there will be Pareto-improving trades. Alternately if the government knew the marginal benefit schedules of the lab and the bar, then it could regulate the noise level to be precisely N*. In the current case it would seem implausible that the government could really know all of that information, however in other cases the informational asymmetry might not be as large.

Steve Levitt (in his Freakonomics blog) gives the simple example of web addresses. For a simple example, consider the web domain name "kevinfoster.com". There are various people who might value this address (I checked – right now it's registered but just left blank).

Suppose I value the address at $100. Suppose that some business called "Kevin Foster" values the address at $120. If the property rule is "first come first served" and I was quick then I own that web site. So the business would offer me some price between $100 and $120, say $110, and we would both be better off – I would get $10 of surplus and the business would get $10 of surplus. Suppose instead that the property rule was "businesses get .com addresses" so that the business owns the web site. In that case they take it – I would not be willing to pay more than $100 for it; they would not sell for a price less than $120.

Suppose that, instead, I valued the address at $150. In that case, if I originally owned the name then I would keep it; if the business originally owned the name then I would buy it from them, for some price between $120 and $150.

In either case the entity that values the web address most highly will end up getting it – as long as they can make the transaction.

In the internet name case, the property rights were unclear initially: people named "McDonald" grabbed mcdonalds.com and demanded money. At first, the hippies who set up the internet tried to restrict sales, which just led to confusion. Businesses tried to use existing trademark protection law to grab domain names, so it took lengthy legal proceedings to figure out just who owned it in the first place. Once initial ownership was decided, trade could flourish.

Of course there are differences in the flow of money – if I already own the name then either I get paid (if the business values it more) or I don't have to pay (if I already own it). The participants in the transactions care greatly about the initial property rights allocation. But, as you recall from our discussion of Pareto improvements, from the point of view of maximizing surplus these transactions are immaterial. Neither is a Deadweight Loss – they're losses to one side that are gains to another.

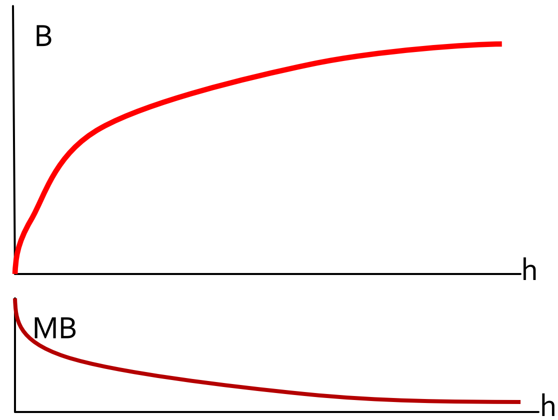
Tragedy of the Commons

A particular case of an externality is called the **Tragedy of Commons**: when everyone can use a resource then they have incentive to over-use it.

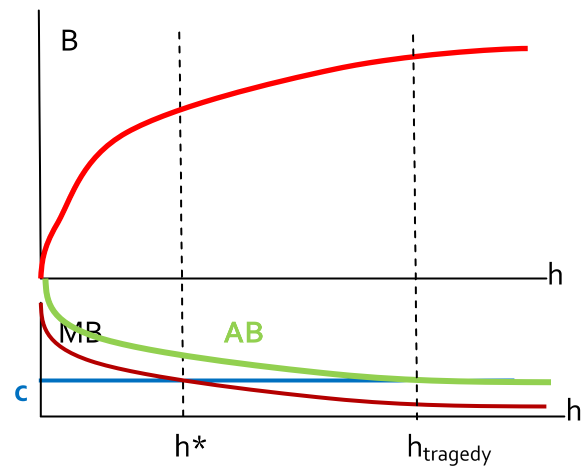
Tim Harford, in his column *The Undercover Economist*, gives an example of popcorn during a movie. If a bunch of friends are all eating from the same bowl then the popcorn will disappear fast. If each person gets their own packet then they'll eat more slowly. I can save popcorn for the end of the movie if I have my own bowl/bag. But I can't save some if it's in the common bowl.

This was initially described as "Tragedy of the Commons" because in ancient times people grazed their animals on common land (a park in Boston is still called "Boston Common" from this). Since access was easy, the land was over-grazed. It has other applications but particularly in things like access to common areas – fishing or hunting, for example. The ocean off the eastern coast of North America was once bountiful with fish; New York City's teeming immigrants were fed on Newfoundland cod. But those areas were overfished and the stock of fish crashed. Now tight restrictions are trying to allow those fish populations to recover.

Numerical Example: suppose a forest is used for hunting and the benefit that accrues to a hunter depends on the number of other competing hunters, so for example, with h being the number of hunters and B the benefit to any one, $B = \sqrt{h}$ and the marginal benefit is $MB = \frac{1}{2}\frac{1}{\sqrt{h}}$. Graph is to the right.

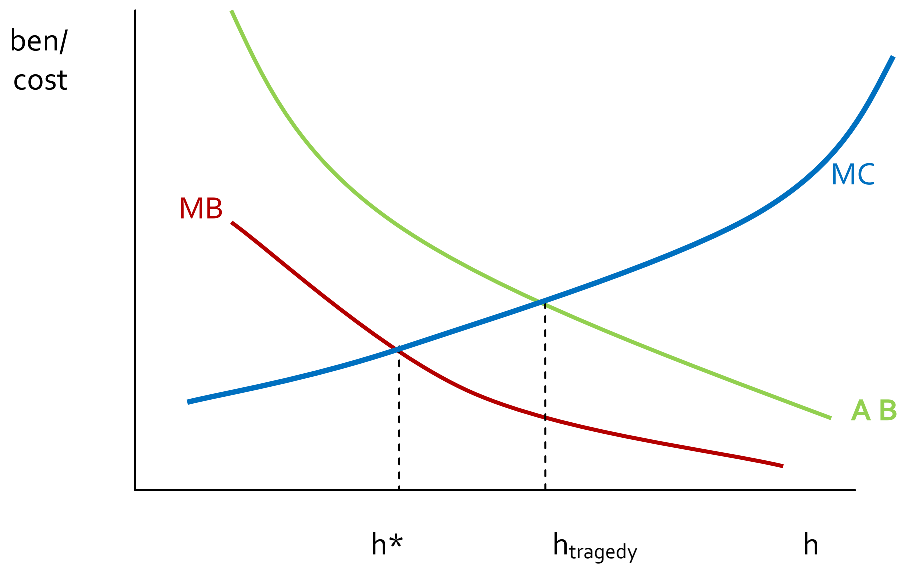


If the marginal cost to each hunter is constant, say $MC = c$, then if the forest were managed by a single entity (person or corporation or government) then that person would allow hunting until $MB = MC$, $\frac{1}{2}\frac{1}{\sqrt{h}} = c$. However if there is no way of keeping hunters out then a hunter would enter as long as the average benefit (AB) per hunter, $\frac{B}{h} = \frac{\sqrt{h}}{h} = \frac{1}{\sqrt{h}}$, is greater than the cost, so hunters would enter until $\frac{1}{\sqrt{h}} = c$. Comparing the two results we clearly see that in the first case, where the forest is managed by a single entity, $h^* = \frac{1}{4c^2}$, while in the second case $h_{tragedy} = \frac{1}{c^2}$ -- four times the optimal amount!



From this it is straightforward to additionally note that, over time, the net increase or decrease in the available benefit is changed by different 'harvest' policies: over-hunting today (if $h_{tragedy}$ is greater than the breeding rate) leads to lower hunting possibilities tomorrow, until the animals are killed off entirely.

Taking a larger look at the graph,



Clearly if MC is upward sloping then the difference between the "Tragedy" level and the optimal level would not be quite as large, but there would still be a gap.

The Tragedy of Commons explains traffic, too. Clear roads are over-grazed – too many people hunt down the quick routes.

The problem can be seen as unclear property rights: if I don't eat fast (or don't go hunting or don't go fishing) then how do I keep a claim on the un-eaten popcorn (or un-killed game or un-caught fish)? We will often return to the problem of unclear property rights.

This simple analysis can be pessimistic; in the analysis of Elinor Ostrom (who won the Nobel prize in economics in 2009) there is more optimism for the ability of communities to properly use common resources. Viewed by a political scientist there is more scope for the policies of a community to have an effect, compared with what simple game theory predicts.

In Ostrom's view (see her Nobel lecture for an overview), "humans have a more complex motivational structure and more capability to solve social dilemmas than posited in earlier rational-choice theory." Many public goods are provided by "polycentric" organizations (multiple government and non-government entities) that interact with other entities, individuals, and companies in complex and diverse settings, which end up often being more efficient than a single monopoly government. Her research focuses on "common pool resources" which are non-excludable but rival (although she does not like that terminology). She also distinguishes "toll goods" that are non-rival but excludable; these can be provided as for example toll roads or bridges or private clubs.

Ostrom rebukes economic theory for being myopic, " The classic models have been used to view those who are involved in a Prisoner's Dilemma game or other social dilemmas as always trapped in the situation without capabilities to change the structure themselves. ... Public investigators purposely keep prisoners separated so they cannot communicate. The users of a common-pool resource are not so limited." Only in common pool resource "dilemmas where individuals do not know one another, cannot communicate effectively, and thus cannot develop agreements, norms, and sanctions, aggregate predictions derived from models of rational individuals in a noncooperative game receive substantial support." In more realistic and complex cases, property rights are not so clear-cut. Identifies at least 5 property rights to common-pool resources: access, withdrawal (harvest), management, exclusion, alienation (selling previous 4 rights to another).