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**Lecture 16: Externalities and Game Theory**

1. Stag Hunt
   1. Most of the time, the Prisoner’s Dilemma does a good job explaining environmental problems. This is particularly clear with the tragedy of the commons.

|  |  |  |  |
| --- | --- | --- | --- |
|  | | Japan | |
| A Little | A Lot |
| China | A Little | 3, 3 | 0, 5 |
| A Lot | 5, 0 | 1, 1 |

* 1. But one can argue that sometimes, the stag hunt works better.
     1. You and a friend are out hunting a stag. Stags are hard to capture and you need cooperation to get it: one scares it into the other player.
     2. You could also not hunt a stag and get a rabbit instead. The rabbit is much smaller, of course, but you can set a trap and catch it on your own.

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| --- | --- | --- | --- |
|  | | Zuko | |
| Stag | Rabbit |
| Aang | Stag | 3, 3 | 0, 1 |
| Rabbit | 1, 0 | 1, 1 |

* 1. Note there are two equilibria here: Stag//Stag and Rabbit//Rabbit. And because you will hurt yourself by not cooperating, we can imagine stable instances of cooperation.
  2. Consider a lake with two hotels on it. Hotels can either keep the lake clean or pollute the lake with runoff (such sewage or dishwater). Polluting is cheaper but any hotel has the power to destroy the lake. In millions, here are their payoffs.

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| --- | --- | --- | --- |
|  | | Zuko’s Hotel | |
| Clean | Pollute |
| Aang’s Hotel | Clean | $6, $6 | $1, $2 |
| Pollute | $2, $1 | $2, $2 |

* + 1. No hotel has an incentive to pollute when everything’s clean because one polluting hotel will harm the entire lake and hurt their bottom line as well as their competitors’. But as soon one pollutes the other will as well and no one will be able to get out of the equilibrium.
    2. A clean equilibrium exists because much (even if not all) of the costs are internalized. They are internalized to the point that it’s enough to prevent pollution, as long as both parties do it.
  1. This has a lot to do with the material from last class. Transferable quotas and Pigouvian taxes help but, like our stag hunt, they require cooperation. The U.S. was able to establish transferable quotas because SO2 emissions notably hurt the voting population even if those quotas also helped foreigners.
     1. Creating a similar system for tuna fleets is harder since tuna travel through so many countries. With so many folks fishing from them, the externality is divvied up among more and more players. Internalization decreases, just as it would if there were many hotels around a much larger lake.
     2. Stag hunts become prisoner’s dilemmas; pollution becomes inevitable.

1. Combating the inevitable: credibility
   1. We’ve talked about how to get out of the Prisoner’s Dilemma: repeat the game with tit-for-tat or grim strategies.
      1. This is how we stop *free riders*—those who benefit from a good (like a clean environment) without paying for it.
      2. If everyone “rode for free,” the good wouldn’t be paid for; it wouldn’t exist at all.
   2. These trigger strategies however require that your threat is credible. If it’s not credible, people will try to free ride. So how do you issue credible threats?
   3. *Punishment cannot be too severe*. We want a severe punishment—to disincentivize free riding—but if it’s too severe it won’t be credible. If we want a country to reduce greenhouse gases, the punishment for defection cannot be invasion. No one will believe anyone will go through with it; such an extreme punishment amounts to no punishment at all.
   4. *Reduce your payoffs from tempting strategies*. By reducing our payoff from defection, we signal to the other party we will stay in. For example, Aang can immediately commits 2/3 of the money ($2) needed to build the sewer pipe away from the lake. It’s now always costlier for Aang to pollute; by eliminating Pollute as a dominated strategy, Zuko will pick Clean.

|  |  |  |  |
| --- | --- | --- | --- |
|  | | Zuko’s Hotel | |
| Clean | Pollute |
| Aang’s Hotel | Clean | $6, $6 | $1, $2 |
| Pollute | $0, $1 | $0, $2 |

Note this doesn’t work very well in a Prisoner’s Dilemma. Why?

* 1. *Outright eliminate strategies*. This amounts to reducing payoffs but in a different way. Rather than commit by reducing your payoffs, commit by making alternative options not possible. Firms do this all the time via delegation:
     1. Send in a power-of-attorney agent to the negotiations. The agent can’t offer an alternative. He can only “sign the contract or walk away.”
     2. Collection agencies only have the power to collect debt, not renegotiate it. Thus creditors are more likely to get what’s owed.
     3. HR departments are where you go to negotiate a higher salary, but HR is always constrained by rules execs put into place. They are a shield against requests for a raise.

Similarly, you can burn bridges. Cortes burned his ships as soon as he arrived in the New World to eliminate the option of him and his soldiers giving up.

* 1. In general, credibility requires that you reduce your options and payoffs to get what you want. Compromise is expensive and risky!