

Game Theory
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Some Applications of the Prisoners' Dilemma

1. **Competition between firms:** Consider for example the Bertrand game from problem set 1 #7. The choice between high and medium prices in that example (in either version) has exactly the Prisoners' Dilemma form, as does the choice between medium and low prices. I.e., this game has two prisoners' dilemma games nested in it. Each firm would like to price below the other in order to steal market share. At the Nash Equilibrium, both firms to set the low price and earn less profit than they would if they both priced high. The same is true of Cournot type games in which firms compete over quantity rather than price. Each firm has an incentive to dump its output on the market unilaterally, but when all firms do this, the resulting low price causes profits to be low. Similar competitive incentives can cause firms to engage in excessive advertising and R&D (excessive vis a vis profits). The outcome of this competition is good for customers (lower prices, better products) but bad for profits.
2. **Public Goods:** E.g., suppose that each individual in a community has the option to purchase a pollution control device for her car. When an individual purchases the device, the benefit (cleaner air) is shared by all members of the community. A very stylized example would be a community of two people. Suppose that a device costs \$100 to buy and creates a benefit to each of the two individuals, which each values at \$70. Then, if the payoffs to neither buying the device are (0,0), we have

Player 1	Player 2		
		Buy Device	Don't Buy Device
	Buy Device	40,40	-30,70
	Don't Buy Device	70,-30	0,0

3. **Safety Regulations:** Consider a sport in which participants are currently not required to wear helmets. Suppose that wearing a helmet reduces your risk of injury but also reduces your performance, so that a player who wears a helmet is at a competitive disadvantage relative to players who do not wear helmets. Consider, for example, a game with two players. Suppose that when an individual player wears a helmet, she gets a benefit of 10 due to the reduced risk of injury, but incurs a costs of 15 due to the reduction in performance, and that her opponent's gets a benefit of 15 due to the relative improvement in her performance. Then we have

Player 1	Player 2		
		Helmet	No Helmet
	Helmet	10,10	-5,15
	No Helmet	15,-5	0,0

If we made the cost to the wearer of the helmet 5 rather than 15, then we would have an assurance game, rather than a prisoners' dilemma.

4. **Trade Restrictions:** Consider two countries who trade with one another. Each is considering imposing additional trade restrictions on the other (e.g., tariffs on imports). Suppose that unilaterally imposing such restrictions creates a benefit to your country of 100 and a cost to the other country of 150. The we have:

Player 1	Player 2		
		No Additional Tariffs	Additional Tariffs
	No Additional Tariffs	0,0	-150,100
	Additional Tariffs	100,-150	-50,-50

5. **Environmental Regulation:** The safety regulation case (#3 above) can be applied to the choices of environmental policy by two countries. Suppose that each country would like to reduce pollution by firms operating in the country. Imposing regulation on businesses would lead to reduced pollution but lead to some reduction in profits and jobs. Further, if one country imposes regulations and the other doesn't, the costs to the first country will be greater, as some businesses will relocate to country two, and some businesses will suffer from competition from cheaper imports. Given these consequences, each country has an incentive to avoid environmental regulation, even if both countries would prefer that both imposed regulations. The same problem applies to labor and human rights laws (concerning sweat shops, the right to organize unions, etc.) and tax policy (cutting taxes to attract capital away from other regions is self defeating when everyone does it).

Notice that in both problems 4 and 5 we have a “race to the bottom” in which each country has a strong incentive to “do the wrong thing.” However, in problem 4, interfering with free trade is the undesirable outcome, whereas in problem 5 not interfering with free trade is the undesirable outcome. A solution to the problem in 4 is to have an international organization like the WTO set uniform trade policy guidelines aimed at keeping tariffs and other trade restrictions low. A solution to 5 is to have the WTO set uniform standards aimed at keeping environmental, labor, and human rights regulation suitably tough, and taxation suitably high. E.g., if each country can impose tariffs on imports from countries with laxer environmental standards, then it will have more of an incentive to maintain its higher standards.